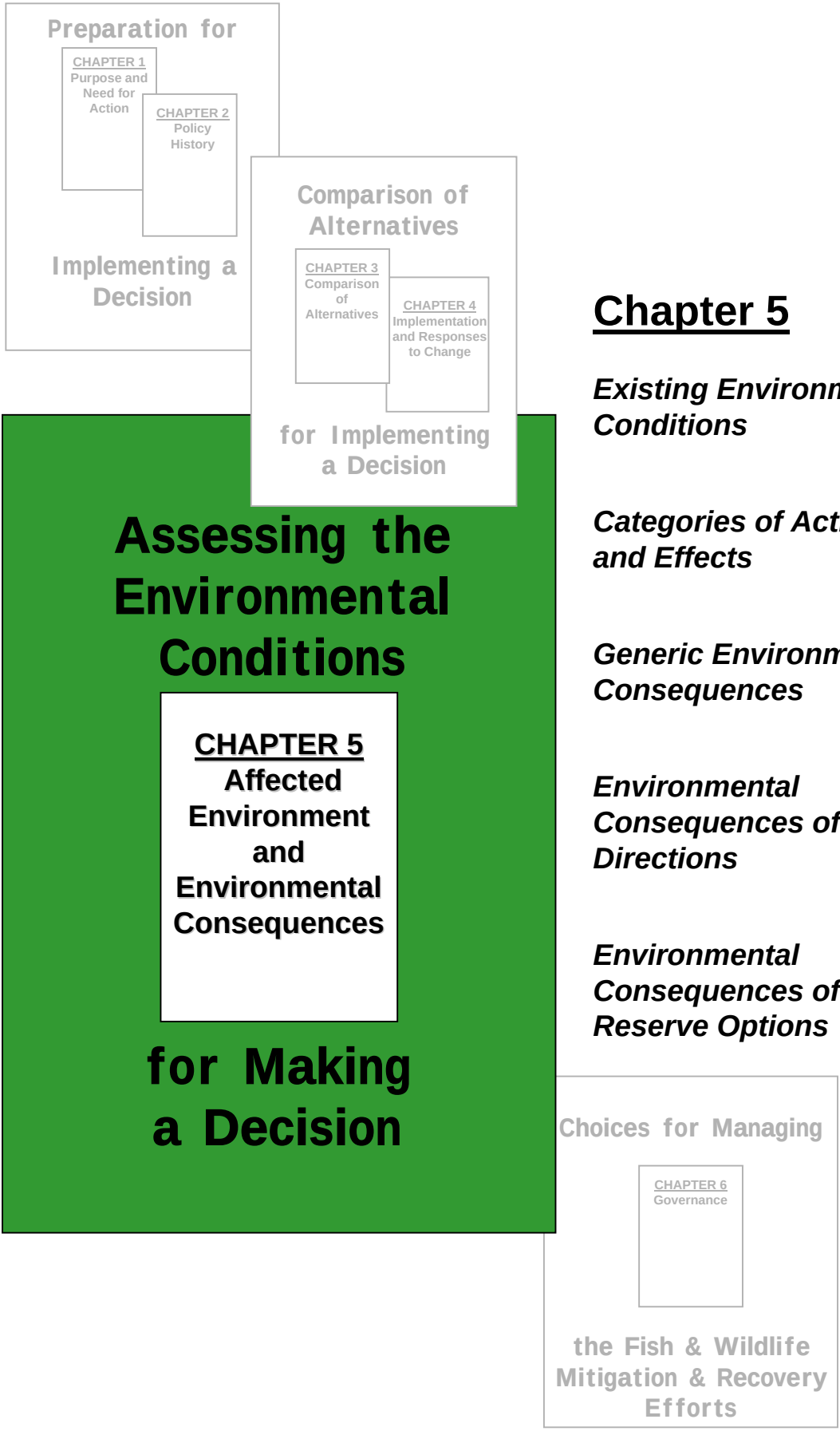
Preparation for
CHAPTER 1
Purpose and Need for Action
CHAPTER 2
Policy History
Implementing a Decision
Comparison of Alternatives
CHAPTER 3
Comparison of Alternatives
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Implementation and Responses to Change
for Implementing a Decision
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Environmental Consequences of Policy Directions
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CHAPTER 5 — ENVIRONMENTAL CONSEQUENCES

- **Describes those aspects of the human environment** that will or may be affected by changes in **Policy Direction** for fish and wildlife mitigation and recovery.
- **Provides a discussion of the generic effects of common human activities on fish and wildlife**, and possible mitigation measures.
- **Provides a discussion of the generic effects of potential fish and wildlife actions on human activities,** and possible mitigation measures.
- **Briefly reviews the methodology that underlies the analysis of environmental consequences for this EIS.**
- **Describes the environmental consequences of the alternative Policy Directions.**
- **Describes environmental consequences of Reserve Options**

Information found in this chapter is the technical and detailed analysis of the environmental consequences for implementing each alternative Policy Direction. For a summary of the philosophy behind each of the alternative Policy Directions and for a summary of the effects, please see Chapter 3 (Comparison of Alternatives).

This chapter is organized to allow logical review of the affected environment and the environmental consequences of implementing actions consistent with each of the Policy Directions. The analysis in this document focuses on the policy level. The description of environmental consequences is based not on numbers, but on a broader and more general qualitative analysis—an analysis built on observable relationships among policies, people, and the environment. We have demonstrated in other processes that use of these basic relationships will lead to a more reliable understanding of the environmental consequences of our actions, appropriate for this level of decisionmaking. Analysis at the policy level accommodates changing conditions and provides greater flexibility in making decisions concerning specific actions.

Refresher: *The items below are summarized from Chapters 3 and 4 to provide a quick review for the reader.*

(1) To arrive at the Policy Directions discussed in this FEIS, we studied the regional processes and proposals recently completed, identified the key issues, and collected potential implementation actions. From this information, several broad policy themes emerged.

(2) The Status Quo is the No Action alternative, an option for continuing into the future with no Policy Direction change, using all the same implementation actions in use prior to 2002.

(3) All of the Policy Directions assume that the human population will grow and development will continue, though each Policy Direction can influence these rates of growth.

(4) This EIS explores the environmental consequences of implementing each Policy Direction. With this information in hand, the BPA Administrator can assess the potential effects of any given Policy Direction and determine how BPA will meet its obligation to fund and implement fish and wildlife mitigation and recovery actions.

(5) Environmental consequences fall naturally into two areas:

a) major environmental consequences for fish and wildlife and their habitats (air, land, and water) caused by common human activities, and

b) major environmental consequences for humans caused by actions taken for fish and wildlife mitigation and recovery.

(6) The Policy Directions, as defined in this EIS and discussed below in terms of consequences, are not rigidly set. This EIS anticipates that the public or decisionmakers may modify them. Accordingly, three tools to modify Policy Directions have been provided: response strategies, "mixing and matching" components, and reserve options. These tools were discussed in Chapter 4. In addition, provisions have been made to "build your own alternative" (Chapter 3 and Appendix I).

Section 5.1 describes the affected environment. Section 5.2 describes broad categories of actions taken for fish and wildlife mitigation and recovery and the generic effects of these actions on the natural, economic, and social environments. Section 5.3 is the detailed analysis of the environmental consequences of implementing the alternative Policy Directions. Each Policy Direction is evaluated based on its effect on the natural, economic, and social environments. Similarly, in Section 5.4, the environmental consequences of the reserve options are analyzed.

5.1 AFFECTED ENVIRONMENT

This section is intended to provide the reader with a basic understanding of existing environmental conditions, the "Affected Environment." These descriptions are provided to facilitate an understanding of the effects of the Policy Direction Alternatives as evaluated in Section 5.3. Much of the information is summarized from the environmental documents incorporated by reference, especially the SOR Final EIS, the BPA Business Plan EIS, the Corps Lower Snake River Juvenile Salmon Migration Feasibility Report/EIS, and the Interior Columbia Basin Ecosystem Management Project Final EIS. Other sources include the Federal Caucus Conceptual Plan and Basinwide Strategy papers, the Human Effects Analysis of the Multi-Species Framework Alternatives (2000), the *U.S. Department of Commerce's* Statistical Abstract of the United States (1999), and the USDA's Agricultural Statistics (2000).

5.1.1 Natural Environment

The Pacific Northwest's tremendous wealth of natural resources sustained native people for centuries and contributed to immigration that has lasted for more than a century. The settlement and development of the region brought changes to the natural environment that have culminated in the environmental conditions existing today.

The discussion of the existing natural environment described in this section is organized by these effect areas:

- air quality;
- land habitat —use and quality;
- water habitat—use and quality;
- fish and wildlife; and
- ocean and climate.

This section is meant to provide a brief description of the affected environment. For more discussion on each effect area listed above see Section 5.3.2.

5.1.1.1 Air Quality

Generally, the Pacific Northwest region is known for its excellent air quality. However, the air quality of the Columbia River Basin can vary widely because of local air pollution sources, meteorology, and topography. Most sources of air pollution are in urban areas; however, rural areas also contribute to air pollution problems. On the west side of the Cascades there are large urban population centers and high concentrations of emissions from industrial development and automobiles. These areas also support a large amount of agriculture that impacts air quality as a result of field burning. East of the Cascades, the region is less populated and developed. Factors exacerbating air quality problems in this area are the dry climate, proximity to large areas of exposed and highly erodible soils, and wind. Sources of air pollution include agricultural practices and industrial emissions. For example, in the lower Snake River area, a primary source of air pollution is industrial emissions, typically soot and fine wood particles.[1] Throughout the region there are concerns about the impact of thermal power generation on air quality. Air quality is particularly an issue in certain defined air basins—usually in and around large urban areas. In areas already air quality limited, existing and new development must comply with increased restrictions.

The Columbia River SOR EIS identifies three major categories of pollutants (1) urban sources, (2) major single-point emitters, and (3) large areas of exposed soils. Important sources of urban air pollution include internal combustion engines used for transportation, industrial plants, burning of fuels for heating and other purposes, and burning of wastes. Single-point emitters include combustion turbines located in urban

[1] Corps 2002b, Section 4.3.2 Sources of Air Pollutants.

and rural areas. Most areas of exposed soils are agricultural and grazing lands and unpaved roads.

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to set primary and secondary National Ambient Air Quality Standards (NAAQSs) for criteria air pollutants. Primary standards are developed to protect the public health, allowing a margin of safety, while secondary standards protect the public welfare. Public welfare includes protection from decreases in visibility, and damage to animals, crops, vegetation, and buildings. Air quality standards have been established for carbon monoxide (CO), lead (Pb), particulate matter with aerodynamic diameters less than 10 micrometers (PM_{10}), nitrogen dioxide (NO_2), ozone (O_3), and SO_2. Geographic areas with measured pollutant concentrations greater than the NAAQSs are referred to as "nonattainment areas."[2] Other air pollutants—known as "greenhouse" gases—have been determined to contribute to global warming. These greenhouse gases are emitted when fossil fuels, wood products, or solid waste are burned. For a more detailed discussion of global warming, see Section 5.1.1.5 and Appendix F. The air emissions considered in this EIS are carbon monoxide (CO), carbon dioxide (CO_2)[3], oxides of nitrogen (NO_x), particulate matter (PM_{10}), and sulfur dioxide (SO_2).[4] These air pollutants are common to both transportation and power generation.

CO is a colorless, odorless gas that interferes with the oxygen-carrying capacity of the blood. CO has 210 times more affinity for red blood cells than does oxygen. Prolonged exposure to low levels can impair physical coordination and cause dizziness. Continued exposure to CO above 750 parts per million (ppm) can cause death. Ambient CO concentrations do not measurably affect plantlife or building materials.

CO_2 is a natural product of respiration and is produced by burning fossil fuels. It is taken up by plants during photosynthesis. Elevated concentrations are known to accelerate plant growth. Atmospheric CO_2 absorbs heat radiated from the earth, preventing heat loss to space. For this reason, CO_2 is considered a greenhouse gas and has been linked to global warming. It has no health effects at atmospheric concentrations. CO_2 is also produced during the production of natural gas.

Nitrogen oxides (NO_x) can also slow plant growth and reduce crop yield at relatively low concentrations. NO_x are a respiratory irritant that, in the presence of sunlight, combine with hydrocarbons to form photochemical smog (ozone, peroxyacetyl nitrate [PAN], and peroxybenzoyl nitrate [PBN]). Photochemical smog drastically reduces visibility and causes respiratory and eye irritation.

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[2] See generally, Clean Air Act, 42 U.S.C. §§ 7401–7410 (2000).

[3] CO2, though not a criteria pollutant, is considered a "greenhouse" gas. Other "greenhouse" gases include nitrous oxide, water vapor, methane, and ozone.

[4] Corps 2002b, Section 4.3.1.1 Regulated Air Pollutants; and USDOE/BPA 1995, Section 3.6.3 Air Quality.

Particulate matter is made up of fine solid particles suspended in the air that can cause nuisance effects from blowing dust, and health effects from fine particulate matter and airborne chemicals attached to the dust. Animal and plant health effects depend on the size of the particulates and the pollutants contained in the particle.[5] PM_{10} travels deep into the lungs, where pollutants can rapidly diffuse into capillary beds. Elevated particulate concentrations are associated with an increase in the severity and frequency of respiratory diseases. The EPA has recently considered lowering the primary standard because it does not adequately protect human health.

When combined with moisture, SO_2 forms sulfuric acid, which corrodes most building materials, impoverishes soil, affects nearby livestock, acidifies lakes, and kills or damages plant life. Sulfuric acid and SO_2 are both respiratory irritants. About 40% of the natural gas processed in the province of Alberta (Canada) contains sulfur and is termed "sour gas." Processing removes much of the sulfur in gas, recovering it as a salable byproduct.

Barges, trains, and trucks remain the main modes of transportation for moving commodities within the Region.[6] Trains, trucks, and ocean-going cargo vessels are used widely for importing and exporting goods to and from the Region. These modes of transportation, along with automobiles and industrial combustion processes, increase the levels of CO, CO_2, NO_x, and SO_2. Construction activities, agricultural and forestry practices, unpaved roads, and the exposure of sediments can result in increased PM_{10}.

The fuel sources for power generation that affect air quality primarily include natural gas and coal, and to a lesser extent, wood residue.[7] These fuels can cause increases in CO, CO_2, NO_x, SO_2, and PM_{10}. Combustion turbines are situated throughout the Region. Coal-fired plants are located near Centralia, Washington, and Boardman, Oregon. Sulfur dioxide emissions are a major concern for coal-fired plants; nitrogen oxides are more of a concern for natural gas combustion turbines (CTs). Figure 2-5 shows the breakdown of the generation resources projected for operation in the 2000-2001 operating year; Figure 2.6 identifies Non-Hydro Generation sites in the region (see also Appendix E: Energy Generation Facilities.). Figure 2.15 shows the location of major gas pipelines that could supply fuel for existing and new gas-fired CTs. See Appendix J ("per-unit table") for the specific levels of air emissions associated with the different types of power generation.

Reservoir drafting exposes shoreline areas, which are normally underwater, to the drying action of the sun and wind potentially increasing levels of airborne particulate matter.

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[5] Polycyclic aromatic hydrocarbons (PAHs) are formed during the incomplete combustion of fossil fuels, municipal waste, and other organic substances and consist of more than 100 chemicals. Humans are exposed by breathing PAHs bound to airborne particles. Although no harmful effects have been proven in humans, PAHs may reasonably be expected to be carcinogens. Animal studies have shown adverse effects on the reproductive cycle, body fluids, and the ability to fight disease.

[6] Council 2000a, Section 5.3.4 Transportation.

[7] See Appendix E of this EIS.

Clear, windy, summer days typically provide the weather conditions most conducive to high levels of blowing dust. Effects occur primarily around reservoirs located in the drier portions of the Columbia River Basin; both local residents and recreational users of the projects can be affected.

Currently some areas in the Columbia River Basin do not fully meet Federal, state, and local Ambient Air Quality Standards. The most common types of non-attainment in the region involve PM_{10}; however, some urban areas do not meet CO standards. See Figure 2.6 for a map showing air non-attainment areas and federally-protected Class I Areas.[8]

Recent long-term planning estimates by the Council show that the region could need up to an additional 6,000 MW of electricity over the next 10 years. This demand for electricity has led to proposals for a number of new generating resources. BPA is being asked to integrate many of these resources into the Federal Columbia River Transmission System (FCRTS). Since most of these proposed resources are CTs, there is a regional concern for air quality, particularly impacts to federally-designated Class 1, scenic, and wilderness areas. Therefore, BPA initiated a Regional Air Quality Modeling Study to provide clarifying information for the air quality cumulative effects analysis in the Business Plan EIS.

The Regional Air Quality Modeling Study assessed emissions of NO_x, PM_{10}, and SO_2. It compared predicted air pollution from 45 proposed power plants (almost 24,000 MW) to established benchmarks for visibility, National Ambient Air Quality Standards, and nitrogen and sulfur deposition. It also estimated annual CO_2 emissions. The study found that these emissions would not violate regulated air quality standards. The study did show a slight decrease in visibility in some sensitive areas of the region; however, visibility is not regulated at this time.[9]

Impacts to air quality, as a result of fish and wildlife mitigation and recovery actions, are associated in nature. Localized air quality can improve as areas are set aside for fish and wildlife or as industry and land development is regulated. However, air quality may decrease in other areas where development increases due to fewer restrictions. For example, decreasing hydropower generation for fish is not intended to impact air quality. However, the CTs used to replace that hydro power would result in impacts to air quality. Although the action taken for fish was not intended to affect air quality, there were still associated impacts. For a discussion of intended and associated effects see Section 5.2.2.

5.1.1.2 Land Habitat—Use and Quality

The lands within the region can be characterized as three general vegetation types: grasslands, shrublands, and forests. These vegetation types can be broken down further

[8] Designated Class 1 areas include international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size and which were in existence in 1977.

[9] USDOE/BPA 2001d, pp. 1-7.

into upland, riparian, and wetland habitat. Land use in the region has changed dramatically in the last 150 years. Forests have been cut, and grasslands, shrublands, forests and wetlands converted to grazing and agriculture. This loss of quality habitat is further compounded by activities that result in habitat fragmentation, especially in upland and riparian areas. The use or development of some habitat areas is currently controlled or limited by natural resources regulations.

Lands have also been converted for other developed uses. Urbanization of lands causes a loss of the native land characteristics. "Urbanization paves over or compacts soil, and increases the amount of runoff reaching rivers and streams."[10] However, urbanized and agricultural lands, depending on their management, can provide habitat values for some native species.

Table 5.1-1 shows recent land use by ecological province[11] as defined by the Multi-species Framework Process. See also Figure 2.10 for a map of the different land use and vegetation types across the Region.

Table 5.1-1: Recent Land Use of Columbia Basin Lands in the United States by Ecological Province, 1000 Acres Total and Percent by Use

Province	1000 Acres Total	Agri-cultural	Forest	Range-lands	Urban	Water and Wetland
Lower Columbia	11,265	16.9%	74.3%	0.9%	5.4%	2.5%
Columbia Gorge	1,234	18.9%	71.1%	4.8%	1.3%	4.0%
Columbia Plateau	30,136	30.9%	35.8%	30.7%	0.9%	1.7%
Cascade Columbia	4,744	3.9%	71.2%	19.4%	0.4%	5.1%
Blue Mountains	5,014	21.3%	48.6%	28.2%	0.4%	1.4%
Mountain Snake	14,946	6.7%	70.5%	19.8%	0.2%	2.9%
Inter-mountain	5,417	16.9%	70.5%	8.2%	2.2%	2.3%
Middle Snake	20,059	8.3%	26.5%	62.6%	0.6%	2.0%
Upper Snake	23,372	19.2%	13.4%	61.3%	0.7%	5.3%
Mountain Columbia	21,542	5.2%	76.8%	10.2%	0.6%	7.0%
Total	137,729	15.9%	47.3%	32.1%	1.1%	3.5%

Source: Council 2000a: Human Effects Analysis of the Multi-Species Framework Alternatives, 2000

Soils west of the Cascades are generally deep residual or glacial deposits interspersed with rich alluvial stream bottoms.[12] Many of these soils are highly productive, limited only by drainage. In the Willamette Valley, "human induced actions have altered most of

[10] Federal Caucus (1999b), p. 29.

[11] Ecological provinces are groupings of adjoining subbasins with similar climates and geology to account for distinct environments for fish and wildlife populations.

[12] USDOE/BPA 1995c, p. 2-4.

the valley's natural drainage affecting soil productivity."[13] East of the Cascades, river valleys and lower terraces are predominantly young alluvial soils. Uplands tend to have a thin covering of highly erodible wind-blown soils. In the Rocky Mountain portion of the Basin, valley floors are predominantly glacial outwash and glacial alluvium, and upland soils tend to be rocky, coarse and permeable. Soil productivity has decreased due to loss of nutrients and organic matter. Such losses are often caused by exposure of soil to wind and water. Exposure can be caused by agriculture, grazing, trampling, vehicle traffic, and a variety of other human activities. For example, riparian cottonwood forests in Idaho are no longer self-sustaining because dams have eliminated the spring flooding that exposed the mineral soil needed for seed germination.[14]

Overgrazing, introduction of exotic species, and inundation by dam construction has reduced the overall quality and quantity of native upland habitat. For example, introductions of noxious plants contribute to the reduced quality of rangelands and other habitat types; notable examples include cheatgrass, starthistles, knapweeds, and saltcedar. The ICBEMP EIS documents help identify the condition of forests and grazing lands east of the Cascades. Many of these statements are representative for other areas of the Basin as well.[15]

- "Soil productivity is generally stable to declining … sustainability of soil ecosystem function and process is at risk … in some areas."[16]
- "Interior ponderosa pine has decreased across its range…. There has been a loss of the large tree component…. Generally, mid-aged forest structures have increased…."
- "Increased fragmentation and loss of connectivity within and between blocks of habitat … have isolated some habitats and populations…. Fragmentation has isolated some animal and plant habitats and populations and reduced the ability of populations to disperse."
- "Rangeland noxious weeds are spreading rapidly … infestations have simplified species composition, reduced diversity …. Woody species encroachment … have reduced biodiversity."
- "Declines in plant … species are due to a number of human causes including conversion of habitat to agriculture and urban development, grazing, timber harvest, introduction of exotic plant and animal species, recreation, high road densities, fire exclusion, and mining."

The amount and continuity of riparian areas has decreased, primarily because of conversion to agriculture and range, but also because of urbanization, transportation improvements, and stream-channel modifications. The quality of riparian areas has been lost because of excessive livestock grazing and increases in exotic vegetation. Riparian

[13] USDOI/USFWS and BLM 1994. (Northwest Forest Plan)

[14] Smith et al.

[15] USDA/USFS and USDOI/BLM 2000b, Chapter 2.

[16] USDA/USFS and USDOI/BLM 1997, pp. 18-19.

and aquatic ecosystems continue to experience competing developmental interests, associated disturbances, and unsustainable resource extraction. Logging, grazing, mining, water diversions, dams, and other human activities have at least moderately, if not severely, altered or destroyed most riparian ecosystems in the Pacific Northwest. Many riparian areas, floodplains and wetlands that once stored water during periods of high runoff have been developed. For example, agricultural development, channelization, and diking to control flooding along the Willamette River have drastically simplified the once braided system of oxbows, small side channels, ponds, and sloughs that supported extensive marshlands and riparian forests.

Wetlands have also decreased because land use activities have degraded, modified, or destroyed them. However, creation of water impoundments has allowed for some limited increases in wetland habitat. The health of estuaries has declined. Estuarine conditions have also been substantially affected by development. "More than 50% of the original marshes and spruce swamps in the estuary have been converted to industrial, transportation, recreation, agricultural or urban uses. More than 3,000 acres of inter-tidal marsh and spruce swamps in the estuary have been converted to other uses since 1948.[17] Many wetlands along the shore in the upper reaches of the estuary have been converted to industrial and agricultural lands after levees and dikes were constructed. Dam construction and operation up-stream of the estuary has changed the seasonal patterns and volumes of discharge into the estuary. The peaks of spring-summer floods have been reduced and the amount of water discharged in winter has been increased.

5.1.1.3 Water Habitat

Water habitat in the region varies in terms of water quality, instream water quantity, and the amount of river and reservoir habitat for fish and wildlife. Various factors that can affect water habitat include dams, agriculture and ranching, navigation and transportation, forestry, and other industries. New industrial, residential and commercial development also can affect water habitat.[18]

Water Quality

Water quality problems generally originate as intentional use of water for waste disposal, or from non-point source pollution. Non-point sources include irrigation return flows, forestry practices, malfunctioning septic systems, urban runoff, and mining leachates. A long history of mining, logging, and grazing has badly degraded substantial portions of forested eastside river systems such as the John Day, Grande Ronde, Yakima, Wenatchee, Entiat, and Methow rivers. Mining may have deposited new hazardous substances, or disturbed naturally occurring hazardous substances, in floodplain sediments. Some water quality problems are directly related to dewatering streams for irrigation and other water supply purposes. Water quality continues to be a major concern in the region; it is an issue of increasing importance to the Federal agencies involved with regional fish and wildlife decisions.

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[17] Lower Columbia River Estuary Program 1999.

[18] Corps 2002b, Chapter 4.

> "Withdrawing water for irrigation, urban and other uses can increase temperatures, smolt travel time, and sedimentation. Runoff from irrigation can introduce nutrients and pesticides into streams and rivers."[19]
>
> "A 1992 survey of Washington rivers classified 54% of them as not fully supporting designated beneficial uses because of various types of pollution and degradation."
>
> "Until secondary sewage treatment began in the 1950's, large quantities of organic wastes from agricultural and urban operations greatly reduced the water quality along the Willamette River."
>
> "Columbia River streams, both mainstem and tributaries, have been designated as water quality limited under the Clean Water Act. The degraded condition of these streams is directly related to declining fish populations throughout the basin."[20]
>
> "Water quality in streams throughout the Columbia River Basin has been degraded by human activities such as dams and diversion structures, water withdrawals, farming and grazing, road construction, timber harvest activities, mining activities and urbanization. Over 2,500 streams and river segments and lakes do not meet federally-approved, state and tribal water quality standards under the significant cause of habitat degradation and reduced fish production."
>
> "In Oregon and Washington most waterbodies, and in Idaho many waterbodies, on the 303(d) lists do not meet water quality standards for temperature."[21]

Figure 2.7 shows water quality-impaired rivers and streams in the Region. Of the streams surveyed in Oregon in 1988, 95% were determined to be moderately or severely degraded because of excessive sedimentation, high water temperatures, bank instability, or other problems with water quality related primarily to logging and removal of large woody debris from stream channels. Of the 3.4% (1,099 of the 32,150 segments) of Washington State's waters that have been surveyed, 58.5% (643 of the 1,099 surveyed) have been identified by the Washington Department of Ecology as impaired.[22] Pursuant to Section 303(d) of the Federal CWA, 7,994 stream miles and 228,277 lake acres in Idaho have been listed as impaired.[23]

Of these rivers and streams, the one that is receiving perhaps the most attention for water quality issues is the lower Snake River in eastern Washington. This river frequently exceeds state water quality standards, established under the Clean Water Act, for both temperature and total dissolved gases (see Appendix K for a discussion on Clean Water Act issues). For years, there has been a concern that the four Federal dams along this river—Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams—are raising the river water temperatures to levels that are harmful to salmon and steelhead. In

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[19] Federal Caucus 1999b, pp. 28-29.

[20] Federal Caucus 1999b, p. 2.

[21] Federal Caucus 1999b, p. 28.

[22] Washington Department Of Ecology 1998.

[23] EPA 1998a.

addition, research has shown that spills of water from dams can increase the levels of total dissolved gases in the water; if these levels are sufficiently high, they can be harmful or even lethal to non-acclimated fish.

As the owners and operators of the lower Snake River dams, the Corps has been working to address these concerns. The Corps believes that, although temperatures are indeed a concern and the dams likely delay the annual warming and cooling cycle of the river by about a week or two, empirical and modeling data indicate that the dams do not significantly increase water temperatures in the river.[24] The Corps has also identified that improving existing and installing additional spillway deflectors at the dams as a measure that would reduce total dissolved gas levels, and has sought variances from the states for exceedances of state standards.[25] The Corps believes that, because there are several major contributors to water quality problems along the lower Snake River, the appropriate method for resolving these problems is through a TMDL process to be conducted by the jurisdictional states and EPA.[26]

Water quality is divided into four effects subcategories for evaluation in this EIS. These subcategories are discussed below and further analyzed in Section 5.3.

Nitrogen Supersaturation (Total Dissolved Gas)

Nitrogen supersaturation, also referred to as Total Dissolved Gas (TDG), can be found in natural river conditions; however, it is further elevated when water passes through a dam's spillway and carries trapped air into deep waters where the air dissolves into the water. Spill can have the undesired effect of increasing levels of gas supersaturation concentrations downstream.[27] Dissolved gas supersaturation can lead to a physiological condition in aquatic biota known as gas bubble trauma (GBT) or gas bubble disease (GBD). Gas supersaturated water reduces survival of eggs and alevins, results in smaller size at emergence, increases physiological stress, and diminishes growth. As the river flow passes each of the lower Snake and Columbia River dams, sequential spill causes the concentration of dissolved gas in the river to increase, incrementally and cumulatively. Nitrogen supersaturation can affect all aquatic organisms, impacting the aquatic ecosystem structure.

Non-thermal Pollution

Non-thermal pollution can enter surface water from municipal and industrial wastewater, industrial facilities, irrigation return flows, mine runoff, agricultural and grazing runoff, untreated storm water, and septic systems. Agriculture represents the largest nonpoint source of non-thermal pollution and uses the largest amount of surface water within the Basin. Non-thermal pollution can result in direct adverse physiological effects (e.g., bioaccumulation) and habitat degradation. Contaminant pollutants can impair water

[24] Corps 2001a, p. C-8; Corps 2002b, Chapter 4.

[25] Corps 2001a, pp. C-5 – C-6.

[26] Corps 2001a, pp. 8-9.

[27] NRC 1996, p. 229.

quality and degrade aquatic habitat. Increases in non-thermal pollution can also result in changes to pH levels.

Non-thermal pollution includes excesses of organic matter, fertilizers (e.g., phosphates), pesticides (e.g., DDT, aldrin, heptachlor), herbicides (e.g., 2,4-D), sediment (sedimentation is discussed separately below), a large number of metals (e.g., arsenic, lead, mercury), acid mine drainage, and chemicals (e.g., dioxins). Metals originate from many places, including natural sources, construction, urban runoff, wastewater, coal combustion, mining, and smelting. Other pollutants include polycyclic aromatic hydrocarbons (PAHs) and chlorinated hydrocarbons. PAHs come from combustion sources (forest fires, auto exhaust, and the aluminum industry); chlorinated hydrocarbons come from sewer and industrial discharges. Insecticides come from domestic and agricultural uses. Simple grazing of cattle or other livestock near streams and rivers can introduce animal wastes that release potentially harmful chemicals and *E. coli* bacteria.

Tetrachlorinated dibenzo dioxins (TCDD) and tetrachlorinated dibenzo furans (TCDF) are persistent toxic substances that enter the environment as unintended byproducts of several industrial processes. The most significant sources are pulp mills, municipal waste incinerators, and fires involving polychlorinated biphenyl (PCB)-contaminated oil. Although they are no longer manufactured, PCBs are very persistent and are found worldwide, even in the most remote areas. Other potential sources of deposition include the open burning of household waste in barrels.

Non-thermal pollution represents a hazard to aquatic life and human health because of their toxicity at low levels, persistence, and bioaccumulation factors.[28] The primary concern for fish from non-thermal pollution is through ingestion of pollutants. Pollutant toxicity is difficult to describe because there are complex interactions among pollutants; many have similar toxic mechanisms or target organs, compounding their effects. Insecticides generally attack the central nervous system, affecting fight-or-flight responses and systems such as the olfactory senses. Metals can affect multiple organs and metabolic processes such as food utilization, respiration, and growth and reproduction rates, as well as behavior. In addition, some metals (lead and mercury) preferentially target the central nervous system. Copper is particularly toxic to fish and aquatic food-chain organisms. Some metals (nickel, arsenic, cadmium, chromium, and in some cases, lead) are also carcinogenic. PCBs are associated with immunological suppression, reproductive impairment, and cancer. PAHs cause a whole host of problems, including reduced growth, reduced reproductive success, immunological dysfunction, and cancer.[29] It is also well known that immuno-suppressed fish are more susceptible to disease and pathogenic challenges and ultimately experience an increase in mortality.[30]

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[28] NRCC 1981.

[29] NOAA 2001a and 2001b; McCain, B.B., et al. 1990; Arkoosh, M.R., et al. 1991; Arkoosh, M.R., et al. 1994, pp. 33-48; and Stein, J.E., et al. 1995.

[30] NOAA 2001a and 2001b.

Non-thermal pollution can alter cause changes to aquatic habitats, especially reservoir habitat. Reservoirs provide excellent growing conditions for algae. Algal blooms occur where water velocity is low, and nutrients, light intensity and temperature are relatively high. Non-thermal pollution provides the nutrients that encourage algal growth. Algal blooms reduce dissolved oxygen levels for aquatic species.

Sedimentation

Sedimentation is the result of soil erosion, and is measured in terms of turbidity and suspended sediment. Sedimentation occurs naturally from the effects of wind and water on land, including natural landslides, runoff, and flooding. Accelerated sedimentation is caused by erosion caused by human disturbances, including agriculture, grazing, logging, and urban development, as well as channel dredging for river navigation.

Agricultural irrigation contributes to sedimentation in some tributaries because return flows are often high in sediments. Dryland farming and grazing can also contribute to sedimentation through disruption of soil surfaces. Forest practices can cause stream sedimentation through construction and maintenance of roads and stream crossings, use of machinery to harvest and transport timber, and loss of vegetative cover. Landslides of various types occurring along reservoir shorelines also contribute to reservoir sedimentation.

Sediment transport downstream is interrupted by the dams. The dams impound water and reduce velocity, allowing most suspended material to settle on the bottom of the reservoir while the rest remains suspended in the water column—affecting turbidity levels. Reservoir sediments can contain mercury and other hazardous substances.

Reservoir operations such as pool level fluctuations can cause sedimentation. If the water level in a reservoir drops quickly, the increased weight of the saturated materials, along with removal of lateral support from the water, may cause slumping or mass wasting. The effect of reservoir operations on sediment mobility and subsequent movements of hazardous substances is a concern.

Dredging to maintain navigation channels can increase the velocity of the current and the movement of suspended sediments; it can also disturb sediments that may contain toxic substances that are harmful to plants and animals.[31]

Temperature/ Dissolved Oxygen

Storage of water in reservoirs can alter the normal thermal regime of a river.[32] Too much storage can increase temperature because of reduced flow volumes downstream of reservoirs; it can also increase the thermal regime in shallow reservoirs. Deep reservoirs can release too much cold water in hypolimnetic deep-water releases and too much warm water during the winter. Thermal pollution from industrial discharges can also increase

[31] Corps 2002b, Section 4.4.2.1.

[32] Corps 2002b, Section 4.4.2.1.

water temperature. Temperature is a very important characteristic of water quality with the potential to adversely affect some aquatic organisms. Water temperature is one of the critical parameters for salmonids, as well resident fish species in reservoirs.

Temperature extremes can harm fish and aquatic organisms. Salmonids and some amphibians appear to be the most sensitive to water temperatures; they serve as indicator species for water temperature and water quality. Too much cold water can delay egg development and migration of salmon. Too much warm water can stress salmon physiologically and become lethal, depending on exposure time, or can trigger premature egg hatching. Above-optimal temperatures accelerate development of eggs and alevins, cause earlier fry emergence, increase metabolism, increase primary and secondary production, increase susceptibility of both juveniles and adults to certain parasites and diseases, and increase predation on juvenile fish. Mortality of salmonids occurs at sustained temperatures of greater than 73 degrees Fahrenheit. Sub-optimal water temperature can also cause cessation of spawning, increased egg mortalities, and susceptibility to disease.[33]

Adequate dissolved oxygen (DO) concentrations are important for supporting fish, invertebrates, and other aquatic life. Salmon and trout are particularly sensitive to reduced DO. The capacity of water to hold oxygen in solution is inversely proportional to temperature. For example, higher stream temperatures result in lower DO concentrations. DO concentrations can vary with length and width of river and reservoir systems, depth, and time. Mainstem changes in temperature and DO levels are associated with dry years, low flows, long retention times, and solar radiation. Tributary problems could be more closely linked to the timing, and quantity of irrigation diversions, low storage releases, altered channel geometry, increased solar radiation through loss of riparian and stream bank shading, and irrigation return flows.

Water Use and Habitat

Water use is the diversion or instream application of water to human uses, including agricultural irrigation, municipal water supply, hydropower, navigation, and waste disposal. Water use is the limiting factor for the amount of instream water. For example, storage of water for winter hydropower generation and spring flood control has substantially altered the natural runoff pattern by increasing fall and winter flows and decreasing spring and summer flows resulting in fluctuations in instream water quantity.[34] Water habitat is the amount of available habitat for aquatic species and is evaluated in terms of the amount stream/river and reservoir habitats. The quantity of instream water coincides with the amount of available habitat. Water quantity problems are a significant cause of habitat degradation and reduced fish production.[35] Withdrawing water from streams can increase temperatures, sedimentation, and smolt travel time.

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[33] Federal Caucus 1999b and 2000b, Habitat Appendix, p. 134 and Hydro Appendix, p. 39.

[34] Federal Caucus 1999b, pp. 66-67.

[35] Spence et al. 1996.

Large hydroelectric dams on the mainstem and major tributary sections of the Columbia and Snake river systems present barriers to salmon, lamprey, and white sturgeon movements and alter river flow rates and patterns to the detriment of many fish populations.[36]

> "Hydropower dams on the Columbia and Snake rivers have blocked and inundated mainstem habitat, altered natural flows for fish and aquatic species, impeded passage of migrating fish, and created a series of pools where fish predators reside."[37]
>
> "Millions of acres of land in the basin are irrigated. Although most withdrawn water eventually returns to streams from agricultural runoff or from ground water recharge, crops consume much of the water. Withdrawals affect seasonal flow patterns by removing water from streams in the summer (mostly May-September) and restoring it to surface streams and ground water in difficult-to-measure ways."[38]

Water use and habitat is divided into three effects subcategories for the evaluation in this EIS. These subcategories are discussed below and further analyzed in Section 5.3.

Instream Water Quantity

The amount of water instream varies naturally throughout the year. Reduced water quantity is a major cause of habitat degradation and reduced fish production. Water withdrawals throughout the region reduce the amount of river and stream flow. The purposes of these withdrawals include consumption, storage, irrigation, and groundwater storage. Tributaries, arid areas, and areas upstream of the lower Snake River dams experience the most substantial adverse effects from water withdrawals. Water withdrawals and changes to natural return flows can affect seasonal flow patterns and increase temperatures, smolt travel time, and sedimentation. Urban watersheds with large proportions of impervious surface areas can cause changes to the natural runoff and return flows resulting in altered stream flows.

Also, water diversions for municipal uses (such as drinking water, industrial uses, or irrigation water supply) have affected many lakes, especially during drought.[39] Regulation of lake levels for water supply has affected near-shore aquatic and wetland plant and animal communities, as well as the spawning success of near-shore spawning fishes. Surface water withdrawals can directly dewater streams and rivers (especially in dry years), impeding access to spawning areas, uncovering eggs (causing them to dry out), increasing water temperatures, and causing direct mortality or injury by sucking fish into the water intakes. Surface and groundwater withdrawals can also lower groundwater tables, possibly affecting deep-rooting plants and stream flows. Additionally, inter-basin

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[36] Smith et al.

[37] Federal Caucus 1999b, pp. 1-2.

[38] Federal Caucus 1999b, p. 28.

[39] NRC 1996.

water transfers have promoted the spread of non-native plants and animals while inhibiting natural migration routes of native species.[40]

Amount of Stream/River Habitat

The quality and quantity of freshwater habitat in much of the Columbia River Basin have declined dramatically in the last 150 years. Some species of fish and wildlife associated with stream and river habitat for part or all of their life stages are affected by decreases in available habitat.

The amount of stream/river habitat is often a function of instream water quantity. Activities such as logging, farming, grazing, road construction, mining, and urbanization have changed the historical habitat conditions of the Basin.[41] Sometimes creating passage obstructions, these activities can also result in making suitable habitat inaccessible and disconnected. The widespread removal of large woody debris from streams, lack of recruitment of new woody debris, and increased sedimentation from logging and other land uses have reduced the structural diversity of instream habitats (for example, the large, deep pools that are essential components of high-quality fish habitat) for fishes and other aquatic organisms in many of the region's streams.

The amount of stream and river habitat is also related to the highly regulated nature of the river system. Mainstem habitats of the Columbia, Snake, and Willamette rivers have been affected by impoundments that have inundated large amounts of spawning and rearing habitat, reducing that habitat, for the most part, to a single channel. Of the original salmon and steelhead habitat available in the Columbia River Basin, 55 % of the area and 31 % of the streammiles have been eliminated by dam construction.[42]

Floodplains have also been reduced in size, off-channel habitat features have been lost or disconnected from the main channel, and the amount of large woody debris (large snags/log structures) in rivers has been reduced. Most of the remaining habitats are affected by flow fluctuations associated with reservoir management, at least along the larger rivers and streams. "In 1998, the Council designated 44,000 miles of river reaches in the Basin as protected areas [where the Council believe hydroelectric development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity or their habitat]."[43]

Amount of Reservoir Habitat

The FCRPS consists of 31 major dams with hydropower facilities on the Columbia River and its tributaries. Some of these are considered run-of-river dams, others maintain large reservoirs for flood control, irrigation, recreation, and other uses. Generally, the amount of reservoir habitat is directly related to the amount of water storage. Reservoir

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[40] USDA/USFS and USDOI/BLM 2000a, Chapter 2 at p. 29.

[41] See Section 5.2.2.1 of this FEIS.

[42] Council 2000d.

[43] Council 2000d.

operations can affect water temperature, velocity, and sedimentation. Reservoirs can adversely affect certain species of anadromous fish by causing extended travel times, residualization (failure to migrate), and decreased survival rates. "The reservoirs have also substantially modified the temperature of the river and provide ideal habitat for salmon predators."[44] Fluctuations in reservoir habitat from reservoir operations can result in increases and decreases in the available aquatic habitat for those species that depend on it. Reservoir habitat can be lost temporarily or permanently as a result of irrigation and domestic use withdrawals, natural droughts, and flow modifications to the hydrosystem.

The quality of reservoir habitat depends on the surface area, the overall volume of water, and associated habitat features. Reservoirs provide both surface habitat and water column habitat for fish, other aquatic organisms, and wildlife. For example, some species of waterfowl and raptors (e.g., Canada geese and osprey) benefit from the open waters and shallow areas of reservoirs, while diving waterfowl (e.g. mergansers) and native resident fish benefit from the water column habitat. Resident fish can use different reservoir habitats during different life stages.

5.1.1.4 Fish and Wildlife

The diverse habitats of the Pacific Northwest are home to a wide variety of fish and wildlife species. Many of these species are specifically adapted to a particular niche, while others can be found across a variety of different habitats. Throughout history these fish and wildlife resources have played an important role in shaping the spirituality, culture, and economies of the Region. Different people place different values on these resources, and these values change over time. These value systems can be categorized as consumptive use, non-consumptive use, and non-use. Consumptive uses, including subsistence, are often characterized by hunting, fishing, trapping, and collecting; while examples of non-consumptive uses include wildlife viewing and nature photography. However, non-use values occur even though their holder has no intent to actually use or observe the valued resource. Some persons may maintain that they have a moral, ethical, spiritual, or religious responsibility toward other living things, or they may express empathy or equity values for fish and wildlife.

Types of non-use values include *existence* values, associated with continued existence of a resource; *option* values, associated with retaining the option to use a resource in the future; and *bequest* values, associated with maintaining the resource for future generations. Economists and other social scientists are largely unanimous in their belief that non-use values exist and that they are justifiable economic values. However, there are no easy ways to quantify the economic value, so its measurement must rely on a variety of indirect methods.

Today, many species, aquatic and terrestrial, are substantially diminished in numbers relative to historical levels. Recovery efforts focus on those species at risk of extinction, while mitigation efforts are conducted for those species impacted from the development

[44] Federal Caucus 1999b, p. 67.

of the FCRPS. Anadromous species throughout the Region face increasing pressure and continue to be listed under the ESA.

> "Native salmon and steelhead … are in decline throughout the Columbia River Basin. Recent analyses indicate that extinction risks for Snake River salmon and steelhead populations are significant. The National Marine Fisheries Service (NMFS) has listed 12 Columbia River Basin salmon and steelhead Evolutionarily Significant Units (ESU) as threatened or endangered under the Endangered Species Act (ESA)."[45]

These problems extend to many of the region's resident fish as well:

> "(M)any resident fish species are in decline throughout the Columbia River Basin. Bull trout have been listed as threatened and Kootenai River white sturgeon have been listed as endangered by the USFWS under the ESA."[46]

The same desire to protect the Region's wildlife resources is also prevalent.

> "[A]s we craft a plan, we need to protect the long-term health of our forests, wildlife, and our waterways…. [W]e hold them in trust for future generations."[47]

The plight of the Region's fish and wildlife resources has been both partially caused by, and made worse through, the introduction and spread of non-native species.

> "Throughout the world, [non-native] species have become a hazard of immense proportion both for economic as well as ecological reasons."[48]

Changes in both terrestrial and aquatic habitat conditions, introduction of non-native species, and increasing human development and utilization have resulted in changes to many species of fish and wildlife. Figures 2.8 and 2.11 show the areas where anadromous fish, resident fish, and wildlife have been listed as threatened or endangered (see Appendix C for a more recent listing of fish and wildlife species).

Native Anadromous Fish (Naturally Spawning and Hatchery-produced)

The Pacific Northwest supports a variety of anadromous fish species. These species have a complex lifecycle spending time in both fresh and salt water. Anadromous fish are hatched in freshwater rivers and streams and then, after several years, migrate out to the ocean to mature. As adults they then return upstream to spawn. Native anadromous fish species include pink, coho, chinook, chum, and sockeye salmon; steelhead and sea sun cutthroat trout; white sturgeon, and Pacific lamprey. All but pink salmon spawn in the

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[45] Federal Caucus 1999b, p. 1.

[46] Federal Caucus 1999b, p. 1.

[47] USDOI/USFWS and BLM 1994, s-4. (Northwest Forest Plan).

[48] Moulton and Sanderson 1997, p. 296.

Columbia-Snake River System. In the Pacific Northwest, salmon and trout are highly prized for their commercial and sport fishery value, as well as their importance to tribal harvest, health, spirituality and tradition.

Historically salmon migrated 1,200 miles up the Columbia River into Canada, and 600 miles up the Snake River to Shoshone Falls, Idaho. Since European-American settlement of the Pacific Northwest, anadromous fish populations have declined. Annual runs of salmon and steelhead returning to the Columbia River were estimated at between 8 and 16 million fish before European-American settlement, but had declined to approximately 2.5 million fish by the early 1980s.[49] Reasons for this decline include overfishing, habitat destruction, hydropower development, changing ocean conditions, water withdrawals, and pollution.

Reductions in salmon and steelhead numbers resulted in increased risks of localized extinction of fish population segments (commonly known as stocks). These stocks were protected under the ESA as Evolutionarily Significant Units (ESUs). Many of these ESUs are listed as threatened or endangered, with few healthy wild (naturally spawning) ESUs remaining. As of 2001, there were 17 listed ESUs of salmon and steelhead in the Pacific Northwest (3 listed as endangered and 14 threatened; 12 ESUs listed in the Columbia/Snake River system—9 threatened and 3 endangered).[50] Often these ESUs are characterized by the season of adult migration (e.g., Snake River spring/summer chinook). Although not federally protected, Pacific lamprey are also considered to be on the decline in the Columbia-Snake River System. See Appendix C for a more complete listing of threatened and endangered species.

The passage of the ESA as well as of the Regional Act resulted in the creation of Federal duties to protect, mitigate, and enhance fish and wildlife affected by Federal hydroelectric projects and to ensure that those species listed under the ESA were not jeopardized by Federal actions.[51] These duties have resulted in actions taken to improve habitat and hydro operations to benefit anadromous fish, as well as the creation of an extensive hatchery system.

Hatcheries have a long history of providing fish for harvest and related social and cultural purposes. Until the last decade, hatcheries in the Pacific Northwest produced fish primarily for sport, commercial, and tribal harvest. The proportion of hatchery fish found in the river system has steadily increased. Artificial production represents 70-90% of the run for some stocks (e.g., stocks of coho, chinook, and steelhead).[52] Hatcheries are used to conserve genetic resources and help rebuild natural populations (typically called conservation hatcheries); and mitigate for lost fishing opportunities (referred to as compensation/supplementation hatcheries). Fish are produced in the hatchery and stocked, or outplanted, in different life-stages, in different watersheds.

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[49] Corps 2002b, Section 4.5.1 Anadromous Fish.

[50] NMFS 2002a.

[51] See Chapter 2 of this EIS for descriptions of the Acts.

[52] Federal Caucus 1999b, p. 52.

For years, the response to declining harvest was hatchery construction to produce more fish; however, the focus of ESA efforts is to preserve and rebuild the natural populations and their ecosystems. Thus, hatcheries are no longer seen as the technical solution or the legal solution to preventing extinction. In fact, hatcheries may actually contribute further to extinction. Hatchery production allows harvest at rates too high for wild fish.[53] When wild fish mix with hatchery stock, fishing pressure can lead to overharvest of smaller or weaker wild stocks. With the increase in hatchery production, the portion of wild fish decreased from about 75% in the 1970s to about 25% by the mid- to late-1980s.[54] The high numbers of hatchery-produced fish may cause potential loss of desirable wild-fish genetic characteristics through interbreeding with hatchery fish in the wild; competition between hatchery-produced and naturally-spawning fish for habitat and food; and predation by hatchery-produced fish on naturally-spawning fish. Hatchery-produced fish also may transmit hatchery-borne diseases, and hatcheries themselves may release diseases into streams via water effluents.[55] Other issues also arise between the active recovery of anadromous fish and the health and status of resident fish. Although some resident fish benefit from hatchery practices, most face increased competition for resources with anadromous fish, and pressure from resource management directed at decreasing the resident fish population (e.g., northern pikeminnow). Many of these issues are the subject of ongoing research but may contribute to the overall decrease in wild fish populations.

Another impact of hatchery-produced fish is the potential unknown effect of genetic introgression into wild fish from the hatchery strays. Some proportion of hatchery fish reproduce in the wild. Fish not subject to natural selection may carry linked genes or resistant strains of disease that could lead to inbreeding depression or non-adaptive traits. By altering natural selection, humans induce genetic changes in the anadromous fish population that may further degrade wild fish when hatchery-produced and naturally-spawning fish interbreed. Therefore, when spawning occurs, a fish that might have been eliminated in the wild by natural selection is now contributing to the gene pool.[56] Theoretically, interbred fish are less adapted to and, therefore, less productive within the unique local habitats where the original native stock evolved.[57] More recently, harvest managers have instituted reforms including weak stock, abundance-based, harvest rate, and escapement-goal management.[58]

Even hatcheries producing fish that are originally from a native population, intended only to supplement the run, can harm the native population. Broodstock fish are typically selected for their large size and early returns. However, these larger, more aggressive fish can compete with and consequently decrease numbers of wild fish in stocked

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[53] Federal Caucus 1999b, p. 11.

[54] Corps 2002b, Section 4.5.1.2 Anadromous Fish.

[55] NMFS 2000b, Chapter 5.

[56] USDOE/BPA 1996c.

[57] NMFS 2000b, Chapter 5.

[58] NMFS 2000b, Chapter 5.

streams.[59] The early return runs produce early spawning, which is not always helpful in establishing a wild population. If spawning occurs before snowmelt is completed, late high flows could wash away hatchery fry. In contrast, the natural population, by spawning later in the spring, would avoid the high flows.

Where there is a lack of juvenile rearing or adult spawning habitat, hatcheries offer the only option to provide fish to an area and increase fishery opportunities. Hatchery-produced fish can have positive effects on naturally-spawning populations. In supplementation programs, native fish from the local area are used to supplement production of the wild population. This strategy reduces the rate of straying during returning runs and helps to rebuild a strong wild population.[60] With proper marking (adipose clips), it may be possible to target hatchery fish in harvest, depending on gear used or spatial separation from wild stocks. This could maintain harvest, yet take fishing pressure off native populations during recovery. The practice of marking the hatchery fish also allows creel and harvest surveys. These surveys calculate straying and return rates that can be used for future management of harvest and hatchery programs.

Finally, hatcheries can serve as genetic reservoirs of endangered stocks until habitats or passage to blocked habitats can be improved. Hatchery programs can be structured to support the long-term goals of the ESA wild population recovery plan and provide sustainable fisheries.[61]

Figure 2.9 shows the hatcheries and the areas where they have been used to help to increase the number of fish. The role of hatcheries in the future of Pacific Northwest salmon and steelhead is currently unclear; it will depend on the values people place on fish production and biological diversity.[62] For more information on anadromous and resident fish hatchery facilities, please see Appendix G.

Before the development of the Columbia and Snake Rivers, salmon could migrate up and downstream relatively unimpeded. The creation of dams resulted in barriers to migration, longer migration periods, failure to migrate, increased susceptibility to disease, and increased predation. Facilities and programs have been developed and implemented to assist in anadromous fish passage throughout the Columbia and Snake River system. At the dam, anadromous fish may pass through the hydroelectric turbines and/or pass through spillways; and they may be diverted to bypass systems that direct them away from spillways and turbines. Fish passage has been designed to help both juvenile and adult fish migrating up and downstream. Some fish ladders, which help adult fish move upstream, were built when the dams were constructed. Hatchery-produced anadromous fish are also caught in fish traps used in the hatchery programs. Juvenile fish migrate downstream past dams either through juvenile bypass systems or by being caught and transported by barge or truck. Juvenile fish transportation is a means of conveying fish

[59] Ford, M.J., and J.J. Hard 2000.

[60] Federal Caucus 2000b, p. 28.

[61] Oregon Chapter of the American Fisheries Society 2000.

[62] NMFS 2000b, Chapter 5.

past multiple dams and reservoirs to reduce the cumulative effects of dam- and reservoir-related mortality. Juvenile transportation is used to assist out-migrants, but its overall success in terms of returning adults is unclear.

> "Evaluations of transportation conducted over the past 25 years have shown that in nearly all studies, return (juveniles surviving to return as adults) rates are higher for transported fish than those that migrated in-river .... Nevertheless, overall smolt to adult returns (SARs) are still generally lower than they were prior to completion of the lower Snake River dams and John Day Dam on the Lower Columbia River. This has led some to conclude that juvenile fish transportation is ineffective ... . Overall, direct survival of transported migrants is high, estimated at greater than 98%. Behavior and survival of transported fish following release below Bonneville Dam is similar to that of in-river migrants. Some people believe that indirect mortality of transported fish is high (i.e., many of the fish that survived during transportation die later; delayed transportation mortality), but this is a subject of ongoing research."[63]

NMFS has used large volumes of voluntary spill as an interim passage strategy, pending development of more effective alternatives.[64] In general, moderate levels of spill provide increased Fish Passage Efficiency (FPE; passage via non-turbine routes) at relatively low risk. Voluntary spill for fish passage is provided at each of the eight Federal mainstem dams in the spring, limited by interim dissolved-gas limits established by the states of Oregon and Washington. Fish spill is provided at Bonneville, The Dalles, and Ice Harbor dams for 24 hours a day, and for 12 hours a day at John Day, McNary, Lower Monumental, Little Goose, and Lower Granite dams. Voluntary spill is also provided during the summer at Bonneville, The Dalles, John Day, and Ice Harbor dams.

Currently, flow augmentation programs help restore more natural seasonal flow patterns during the time that juvenile salmon and steelhead are migrating downstream. A flow augmentation program, first called for by the Council and later increased under NMFS' 1995 and 1998 BiOps, aimed to restore more natural flow patterns during juvenile salmon and steelhead migration. The 1995 and 1998 BiOps included two flow management strategies: to limit the winter and spring drafts of storage reservoirs to increase spring flows and the probability of full reservoirs at the beginning of summer; and to draft from storage reservoirs during the summer to increase summer flows.[65] The 2000 BiOp introduced a third flow management objective: to provide minimum flows during fall and winter months in order to support mainstem spawning and incubation of listed chum salmon below Bonneville Dam.[66]

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[63] Federal Caucus 1999b, Hydro Appendix, p. 11.

[64] NMFS 1995; NMFS 1998a.

[65] NMFS 1995; NMFS 1998a.

[66] NMFS 2000b, Section 9.6.1.2.1 Flow Management Objectives in Mainstem Columbia and Lower Snake Rivers.

Studies show no direct correlation between controlled releases and survival of spring chinook juveniles. Controlled releases may increase survival of fall migrants.[67] As a result of ESA consultations between the Action Agencies (BPA, the Corps, and the Bureau) and the Services (NMFS and USFWS), numerous changes have been made in FCRPS operation and configuration. These changes have improved survival for the listed fish migrating through the Snake and Columbia rivers. Increased spill at all FCRPS dams allows smolts to avoid turbine-related mortality. Increased flow in the mainstem Snake and Columbia rivers provides better inriver conditions for smolts. Adding new barges and modifying existing barges has also improved the transportation of smolts from the Snake River.

In 2001, voluntary spill for fish passage was altered, in response to near-record low-flow conditions and the power emergency declared by BPA. To reduce the adverse affects on fish passage of 2001 reductions in spill operations, available spill was targeted at those dams that had the lowest fish passage survival and during time periods when a significant portion of the runs were available to benefit. Analysis provided by NMFS indicated that the majority of the benefit of voluntary spill might be achieved at reduced spill levels compared to those called for by the BiOp.[68]

In addition to spill, flow, and transportation improvements, the Corps implemented many other improvements to project operations and maintenance at all Columbia and Snake River dams. These improvements (such as operating turbines at peak efficiency; new extended-length screens at McNary, Little Goose, and Lower Granite dams; and extended operation of bypass screens) are discussed in greater detail in the 1995 FCRPS BiOp.[69] It is reasonable to expect that the improvements in operation and configuration of the FCRPS will benefit all listed Columbia River Basin salmonids and that the benefits will be greater, the farther upriver the ESU.

Fish harvest prior to European-American settlement of the region was estimated at 4.5 to 5.6 million fish annually. With the arrival of settlers and development of canning technologies, commercial fisheries, and recreational fisheries, the annual fish harvest dramatically increased. Eventually, the combined ocean and freshwater harvest rates for Columbia River spring/summer chinook exceeded 80- 90%, which continued to the stocks decline.[70] As those runs decreased harvest shift to fall chinook salmon, which has provided the largest contribution to Columbia River salmon catch from 1890 to today. The mainstem production areas for fall chinook are mainly confined to the Hanford Reach of the Columbia River and to the Hells Canyon Reach of the Snake River.[71] The Hanford Reach is the last free-flowing reach of the Columbia River in the United States above the Bonneville Dam, and home to increasing the Hanford Reach upriver bright wild fall chinook.

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[67] Olsen, D. and J. Richards 1994.

[68] USDOI/Bureau/Corps/BPA 2002b, Chapter 3.

[69] NMFS 2000b, Chapter 5.

[70] Federal Caucus 1999b, Harvest Appendix, p. 3.

[71] Federal Caucus 1999b, p. 29.

Given the variable oceanic migratory patterns and life history traits of salmon stocks, harvest management occurs within a framework of somewhat interconnected state, tribal, Federal, and international law with the goal of equitable allocation of fish stocks among interests while maintaining conservation mandates. Some harvest reforms have occurred in recent years, with an objective of meeting the conservation needs of weaker naturally-spawning stocks present in mixed-stock fisheries. ESA listings, which affect nearly all salmon fisheries on the West Coast, have served to accelerate these reforms.[72] Generally, harvest rates have been reduced in mixed-stock areas, resulting in harvesting in more terminal areas—where stocks can be selectively caught.[73]

Recently, Columbia River adult returns have increased, allowing for an increase in harvest opportunities for sport and commercial fishers. In 2001, the first spring chinook commercial fishery since the late 1970s occurred. Steelhead returns to the Snake River have been at or above historic records, increasing harvest opportunity for fishers. As a result, the harvest rate on some salmon stocks has increased.

Native Resident Fish

Native resident fish are endemic freshwater fish species that live and migrate within rivers, streams, and lakes throughout the Region. In unblocked areas these species mix with anadromous fish, however, they are also found in areas presently and historically blocked to anadromous fish. Most native resident fish thrive in cold or cool flowing water, although some do well in warmer reservoir waters.

Some native resident fish species, including bull trout, redband trout, mountain whitefish, burbot, and white sturgeon, are in decline. Although trout and sturgeon are economically important, they account for a relatively minor portion of total fish numbers. Since the mid-1960s white sturgeon have lacked adequate population recruitment, causing them to be listed as endangered in 1994.[74] Bull trout are estimated to have historically occupied about 60% of the Columbia River Basin; however, in 1998 they were estimated to occur in only 4% of its estimated historical range.[75] By 1999 all five of the distinct population segments of bull trout had been listed as threatened under the ESA.[76] Dams, water pollution and disruptive land use practices have blocked spawning migrations of resident fish, modified habitat, and affected species composition.[77] Specifically, cold-water resident species such as trout and mountain whitefish have declined since the construction of dams.[78] Also, a change in prey organisms might be a reason for the

[72] Federal Caucus 1999b, Harvest Appendix, p. 8.

[73] Federal Caucus 1999b, p.8.

[74] USDOI/USFWS 1994.

[75] USDOI/USFWS 1998b.

[76] USDOI/USFWS 1998c; USDOI/USFWS 1999b; USDOI/USFWS 1999c.

[77] USDOI/USFWS 1998c; USDOI/USFWS 1999b; USDOI/USFWS 1999c.

[78] Corps 2002b, Section 4.5.2.1 Species Composition.

decline of cold-water resident species.[79] See Appendix C for a more complete listing of threatened and endangered species.

Other native resident species (e.g., the northern pikeminnow, largescale sucker, and bridgelip sucker) are found in high numbers, especially in reservoirs. For example, age one and older bridgelip sucker, redside shiner, largescale sucker, and northern pikeminnow accounted for about 70% of all fish sampled in 1979 and 1980 in Lower Granite reservoir.[80] Species such as the northern pikeminnow have been and are being actively harvested for the benefit of anadromous species.[81]

Native Wildlife

Wildlife typically includes mammals, birds, reptiles, and amphibians. Mammals are often categorized as furbearers, small mammals, big game, and non-game. Birds can be dived into several groups such as waterfowl, raptors, shorebirds, colonial nesting birds, passerines, and upland game birds. For this EIS, the term wildlife is treated broadly to include other organisms not traditionally classified as wildlife—such as mussels and snails. This discussion focuses on terrestrial wildlife since most aquatic species of wildlife are affected by the same water quality issues that affect fish.

Native wildlife species in the region vary in degrees of health and abundance. Some species are listed as threatened or endangered, others are substantially diminished, while still other populations are healthy and increasing. Some wildlife species require undisturbed habitats, while others flourish in modified habitats. While development of the hydrosystem harmed some species of wildlife, other benefited. Waterfowl, for example, gained new shoreline feeding and wintering habitat when reservoirs filled behind dams.

Many species continue to be adversely affected by economic growth, urbanization, and habitat fragmentation. Declines in plants and terrestrial vertebrates are attributable to a number of human causes, including conversion of habitat to agriculture, urban development, grazing, timber harvest, introduction of exotic plant and animal species, recreation, high road densities, fire exclusion, and mining. In coniferous forests, logging has greatly reduced forest structures. Populations of associated wildlife species have correspondingly declined—such as Northern spotted owl and marbled murrelet. Both late-successional and younger forests provide habitat for large mammals such as mule deer, cougar, bear, and elk.[82] Fragmentation has isolated some animal and plant habitats and populations, and reduced the their ability to disperse across the landscape, resulting in potential, long-term loss of genetic interchange.[83]

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[79] Corps 2002b, Section 4.5.2.1 Species Composition.

[80] Corps 2002b, Appendix B: Section ES.2 Lower Snake River Resident Fish.

[81] Corps 2002b, Section 4.5.2.3 Aquatic Food Chain.

[82] USDOE/BPA 1997b, p. 43.

[83] USDA/USFS and USDOI/BLM 2000b, Chapter 2 Terrestrial Species.

Most abundant species are either species that easily adapt to changing habitats (e.g. fox, skunk) or are managed as part of a sport hunting and trapping program (e.g. elk, mule deer, beaver). The ESA has protected some native wildlife species experiencing declining numbers by listing them as either threatened or endangered and by designating critical habitat. These actions are expected to ensure the survival and recovery of these species, resulting ultimately in their delisting. Bird species currently listed as threatened or endangered include the bald eagle, spotted owl, and marbled murrelet. Listed mammals include the Canadian lynx, woodland caribou, grizzly bear, Columbian white-tailed deer, and gray wolf.[84] See Figure 2.11 for a map of sightings for the listed threatened and endangered wildlife and Appendix C for a more complete listing of threatened and endangered species.

Non-Native Species

Declines in fish and wildlife can be attributed to the introduction, whether intended or accidental, of non-native (exotic) species.[85] The introduction of exotic species is second only to habitat loss as the reason for species decline. These introduced species prey on, compete with, harbor and transmit disease, and alter the habitat of endemic species. Regional non-native species include fish (e.g., American shad, walleye, smallmouth bass), mammals (e.g., opossum, eastern cottontail, nutria), amphibians (e.g., bullfrog), birds (e.g., ring-necked pheasant, Hungarian partridge, Chukar), mollusks (e.g., zebra mussels, oyster drill, New Zealand mudsnail), and crustaceans (e.g., European green crab, Chinese mitten crab).

Desirable non-native species, such as Chukar and ring-necked pheasant, have become established game species, generating hunting revenues and resulting in specific habitat management goals to increase their numbers. Some non-native species (e.g., bass, catfish, walleye, brook trout, brown trout) introduced for sport fishing now prey on, potentially interbreed with, and compete with juvenile trout and salmon. Some (carp) have been implicated in harboring and transmitting diseases to salmonids. Some, such as the juvenile shad, may provide food sources for juvenile salmonids. However, juvenile shad may also provide food sources for other predators such as the northern pikeminnow, bass, catfish, and walleye, during seasons when juvenile salmon are not as plentiful. This may result in higher predator populations when juvenile salmonids migrate downstream and may increase predation rates and juvenile salmon mortality. Carp cause significant impacts on habitat by rooting up vegetation and stirring up muddy water that affects aquatic plants and other organisms.[86] These exotic species, along with large influxes of juvenile hatchery fish, maintain predator populations at unnaturally high levels, increasing predation on salmon.

Other undesirable non-native species, such as the zebra mussel, can alter entire ecosystems. In the decade since it was first sighted in the U.S., the zebra mussel has been

[84] Information from USDOE/BPA 2000a, Chapter V: Affected Environment, Table V-6, V-7.

[85] USDA/USFS and USDOI/BLM 2000b, Chapter 2 Terrestrial Species.

[86] Kaczynski, V.W. and J.F. Palmisano 1993.

described as "the biggest natural threat to existing freshwater ecosystems of our time."[87] Its presence causes a decrease in phytoplankton and zooplankton, resulting in increased water clarity. Water-quality impacts include increased soluble phosphorus and inorganic nitrogen, and decreased dissolved oxygen—to the point of violating water quality standards.[88]

There have been attempts to regulate and prohibit the introduction of undesirable non-native species both locally and federally. In 1990 Congress passed the Nonindigenous Aquatic Nuisance Prevention and Control Act,[89] and in 1996 ODFW adopted specific rules to regulate and prohibit non-native wildlife.[90]

Compared to other parts of the country, Pacific Northwest freshwater fish communities are relatively sparse in terms of the numbers of species; Oregon has fewer than 70 and Washington less than 50. In the Columbia River, introduced species account for more than 35% of the 80 species of fish. In less than a century, introductions have increased the diversity of fishes in the Pacific Northwest by one-third, from what they were during the previous 10,000 – 12,000 years.[91] However, many of the introduced species have contributed to the continued decline of native fish, such as salmon and steelhead.

While it is difficult to measure the results scientifically, BPA has funded and implemented many fish and wildlife mitigation and recovery actions.

- *Implementing the Council's Columbia River Basin Fish and Wildlife Program directed at protection, mitigation, and enhancement of fish and wildlife affected by the construction and operation of the Federal hydrosystem.*
- *Funding of those activities under ESA specified in the NMFS and USFWS Biological Opinions, and research, monitoring, evaluation, education, and enforcement actions.*
- *Funding of hatcheries requested, planned, and operated by those Columbia River tribes possessing treaty fishing rights; and fisheries improvement projects for the remaining tribes in the Basin.*
- *Fish and wildlife projects protecting over 500,000 acres of habitat.*
- *Fishing net replacement programs to allow tribal fishers to catch more fish from strong stocks in mixed stock fisheries.*
- *Conservation hatcheries, including captive broodstock facilities, to maintain species on the brink of extinction.*

[87] O'Neill, C.R., Jr. 1996, p. 62.

[88] Effler, S.W. and Siegfried, C. 1994.

[89] The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, 16 U.S.C. §§ 4701–4751 (2000).

[90] Importation, Possession, Confinement, Transportation and Sale of Nonnative Wildlife (Wildlife Integrity Program), OAR 635-056-0000 (1996).

[91] Palmisano, J.F. 2002a.

- *Funding the power share of the Corps' Columbia River Fish Management Program and in-lieu fishing sites.*
- *Direct funding of the Lower Snake River Compensation Plan hatchery and evaluation program.*
- *Adopting funding principles in rate setting processes to ensure adequate funds are available for mitigation projects.*
- *Using water from Non-Treaty Storage in Canada for flow mitigation.*

5.1.1.5 Ocean and Climate Effects

The 20th century was the warmest century in the past 1,000 years. Globally, the current trend of very warm years continues. Nine of the 10 warmest years have occurred since 1990, including 1999 and 2000; only 1998 was warmer than 2001. Although the rise has not been continuous, average global temperatures have risen by more than 0.6 °C over the past 100 years.[92] Potential rapid increases in greenhouse gases and related freshwater and ocean warming are issues of concern, as are the historic cyclic climatic and ocean-condition effects on salmon survival in freshwater and marine environments. Changes are forecast to dramatically alter the freshwater ecosystem, benefiting some warm-water species and degrading the habitat for many cold-water species. For example, precipitation that had occurred as snow and effectively stored could occur as rain in the future and run off immediately. Long-term trends in Columbia River streamflow (1858 to 1998) show a decline of about 19% in average flow as a result of natural conditions (although there is no similar trend since 1900).[93]

In the Columbia River Basin, annual average temperature has warmed about 1.0 °C over the last century. However, the rapid changes in warming in this century relative to the previous nine centuries are trivial, compared to the astonishing changes that global warming models project for the near future: each coming decade may successively add nearly as much warming as the entire 20th century. Because such events are outside of the evolutionary experience of salmonid populations, they will be ill-adapted to both the rate of change and the climatic conditions. Effects of climate change on salmonid populations, already clearly sensitive to climatic variation within our historical baseline, will be both unpredictable and large.

Changes in marine survival also appear to be related to these sudden shifts in the climate of the ocean and atmosphere. In the ocean, fish may be unable to adapt rapidly to the anticipated changes, potentially contributing substantially to reduced ocean survival. Because fish are cold-blooded, and their metabolism is a function of water temperature, their growth will decrease if the water warms and food supply does not increase. Growth

[92] Material in the next three paragraphs is drawn from the following sources: Welch, D.W. 2002; Welch, D.W., Whitney, F., Bertram, D., Harfenist, A., and Tucker, S. 1999; Welch, D.W. 1999. (Appendix F of this EIS); Welch, D.W. In press. pp. 4, 15.

[93] ISAB 2001.

of most of the salmon stocks studied has in fact decreased over time,[94] directly affecting the number and viability of the eggs. Although global warming is a very gradual process, gradual changes accrue to "trip" major changes in an ecosystem. For instance, when water temperatures warm one degree or two, the change may not have much impact. But when that one degree is enough to cross the threshold where ice turns to liquid water, the change may have greater impact, as in the Antarctic where krill feed on algae that live and grow in tiny tubules in the ice. Today the Antarctic krill population is only about one-fifth of what it was 20 years ago.[95]

Open-ocean salmon research conducted from 1990-1995 indicates that global warming will present salmon with great survival difficulty in the long term. The West Coast has already seen significant reductions in marine survival stretching from Oregon to Alaska, with the greatest losses occurring in southern regions. Oregon coastal coho and Keogh River steelhead experienced a large drop in ocean survival during the 1990s. These rivers have no hydro system-operation impacts, and the Keogh River is considered pristine, with no known changes in freshwater habitat. The ocean survival of Oregon coastal coho salmon has decreased in the 1990s to one-tenth of the survival recorded in the 1960s. Thus, the changes in ocean habitat are now returning only one adult for every ten that would have returned in earlier, more productive, times.

In British Columbia, many southern stocks of coho, chinook, and steelhead have also seen ocean survival decrease sharply since 1990, bringing some stocks to the verge of extinction in less than a decade. In addition, recent changes in the ocean survival of Alaskan salmon have sharply reduced catch levels. In each region, the primary cause of the sharp declines has been changes in ocean survival. These changes in marine survival are very alarming. They have occurred extremely swiftly, and have rapidly made formerly healthy populations unsustainable—even with the termination of all fisheries.

Ocean conditions are largely beyond human ability to manage. However, it is important to understand and measure the magnitude of marine condition effects on salmon because it is important to understand the partitioning of survival between the freshwater and marine systems[96] and because ocean conditions are recognized as a major cause of poor survival and declining populations. The relative success of restoration efforts in freshwater habitats cannot be accurately estimated if survival in freshwater is confounded with ocean survival.[97] Mortality related to ocean conditions may in fact overwhelm the effects of any action taken in the freshwater portion of the salmon life-cycle, resulting in

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[94] Bigler, B.S. et al. 1996.

[95] Trivelpeice, W.Z. 1997.

[96] Pearcy, W.G. 1996a.

[97] Consider, for instance, this scenario. If ocean conditions improve in several years and coho survival increases, how will we know how much credit to give to the actions of a plan? This partitioning of survival concept furthered by Dr. Pearcy was also a key recommendation of the Ocean Survival workshop in Newport, OR, in March 1996.

misinterpretation of the effects of management actions taken in the hydro corridor or Basin tributary streams.[98]

According to Whitney,[99] a fundamental assumption of the Northwest Power Planning Council's Fish and Wildlife Program (which has become the basis for much of the research, monitoring and for the dominant rationale for actions taken within the hydrosystem corridor and Columbia River tributaries) is that the number of adults recruited is primarily a simple, positive response to the number of smolts produced. (Stated another way: human-induced losses of natural production can be mitigated by actions to increase the number of smolts surviving to below the last dam.) In fact, there is substantial evidence that the long history of hatchery development, coupled with mixed-stock fisheries, is a large factor in the decline of Columbia River stocks. Certainly, for many stocks, there is no simple relationship between numbers of smolts produced and adults returned. Salmon spend most of their lives and gain 99% of their weight while residing in the marine environment. This fact does not argue for abandoning actions within the hydrosystem, but strongly argues for the importance of greater understanding of all life stages.

Projected global warming is sufficient to move the temperature limits that determine where some species of salmon feed entirely out of the Pacific Ocean and well up into the Bering Sea. If this occurs, then within this century, several species of Pacific salmon would no longer be able to thrive and grow successfully in the Pacific Ocean. In at least some stocks, recent changes in ocean survival are much larger than changes in freshwater survival. If the ocean habitat continues to deteriorate as over the last two to three decades, then threatened salmon populations may become unsustainable despite concerted efforts to restore or improve freshwater habitat. Climatic changes anywhere near projected levels may prevent fisheries scientists from being able to effectively provide credible assessment and management advice in a sufficiently timely manner to prevent major fishery collapses. Simply put, the changes will be beyond our ability to manage and therefore are outside the scope of this EIS. For more information on Global Warming and Ocean Conditions, please see Appendix F.

5.1.2 Economic and Social Environments

The Pacific Northwest recently experienced rapid population growth in comparison to the nation as a whole, and this is expected to continue. The recession during the 1980s had contributed to outward migration; however, enhanced economic prospects in the 1990s reversed this trend and more people moved into the Region. A recent downturn in the economy, resulting in high unemployment rates, has slowed regional economic growth.

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[98] To emphasize this relationship, it is important to understand that if survival in the ocean is on the order of 5%, a one-to-two percent change in survival will be reflected in a 20 to 40% change in adult returns. However, when in-river survival during smolt outmigration to the ocean is of the order of 50%, a one-to-two percent change in freshwater survival will produce only a 2-4% change in adult returns. Source: Ryding and Skalski 1998.

[99] Whitney, R.R., et al. 1993.

Only a few decades ago, economic growth was fueled by natural resources industries such as agriculture, fishing, mining, and forestry, and inexpensive hydropower—important in attracting energy-intensive industries. Most rural communities remain economically and culturally tied to the natural resource industries, especially agriculture. Now, consistent with national trends, the regional economy has evolved a more diverse base, with notable growth in technology, transportation, trade, and service sectors. The region's natural location on the Pacific Rim and its relative proximity to Asian markets provides a continuing advantage that has also influenced present-day economic development.[100]

With declines in rural areas and expanding urban economies, the disparity in earnings and unemployment rates between urban and rural areas has increased. Still, the natural resource industries play important roles in the region's economy. They provide relatively stable jobs in rural areas, they create jobs in transportation, forward processing and related industries, and they contribute to foreign exchange earnings.

Growing populations and increased regional development has resulted in higher demand for electricity. These increases have had negative effects on the Region's fish and wildlife populations, as well as its cultural and historic resources. These negative effects have impacted the Region's many Native American Indian tribes. Increased pressure on the hydrosystem has resulted in higher funding costs required to protect, mitigate, and enhance natural and cultural resources.

An increasingly urban population is demanding increased recreational opportunities and environmental quality. The tourism industry provides economic stimulus in less populated regions and creates economic activity in the service and trade sectors. At the same time, rural development is threatening the qualities that make rural places attractive for recreation, retirement, and new business.

The urban and rural areas are closely linked in the Pacific Northwest. Today, some parts of the region—especially larger urban areas—are experiencing problems with congested roads, overburdened infrastructure, and concerns about air and water quality. Many of the region's residents value the quality of life afforded by smaller cities, clean air and water, outdoor activities, and open spaces. Increasingly, more people are leaving the traditional suburbs for homes in more rural areas. Sustaining the quality of life and managing the effects of a quickly growing population have become important to many rural residents.

Table 5.1-2 shows data on population, value of output, income and employment for the nation and for each of the four states with an important share of their economic activity in the Basin.

[100] This paragraph paraphrased from USDOE/BPA 1995c, Appendix O Sec. 2.1.1.

Table 5.1-2: Summary of Socioeconomic Measures for the United States, and by State

Measure	Year, Units	United States	Washington	Oregon	Idaho	Montana
Population	1997, thousands	267,636	5,610	3,243	1,210	879
Gross Regional Product	1996, billion dollars	$7,631.0	$159.6	$87.0	$27.9	$18.5
Employment	1996, employed civilian labor force	126,708	2,699	1,619	587	423
Unemployment Rate	1996, % of civilian labor force	5.40%	6.50%	5.90%	5.20%	5.30%
Income	1997, billion dollars	$6,851.0	$149.9	$79.1	$24.8	$17.6
Income per Capita	1997, dollars per person	$25,598	$26,718	$24,393	$20,478	$20,046
Full-time and Part-time Employment Shares by Industry: 1996						
Farm, Agricultural Services, Forestry, Fishing		3.2%	4.3%	5.4%	8.0%	6.9%
Mining		0.6%	0.2%	0.2%	0.6%	1.4%
Construction		5.4%	5.7%	6.0%	7.7%	6.5%
Manufacturing		12.9%	11.7%	13.6%	12.2%	5.9%
Transportation and Public Utilities		4.8%	4.5%	4.6%	4.5%	5.1%
Wholesale Trade		4.7%	5.0%	5.2%	4.8%	4.0%
Retail Trade		17.2%	17.6%	18.3%	18.9%	20.6%
Finance, Insurance, Real Estate		7.5%	7.4%	6.6%	5.6%	6.3%
Services		31.0%	29.5%	30.2%	27.1%	31.6%
Government		14.5%	16.6%	13.4%	16.0%	16.8%

Source: Council (2000a), Human Effects Analysis of the Multi-Species Framework Alternatives, Appendix A.

The following discussion for this section of the existing economic and social environments is described by these broad categories:

- Commerce,
- Recreation,
- Economic Development,
- Funding Costs,
- Tribal Interests,
- Cultural and Historic Resources, and
- Aesthetics.

These subsections are meant to provide a brief description of the affected environment. For more discussion on the effect areas listed above see Section 5.3.3, the table discussions on Existing Conditions and Status Quo for each effect area.

5.1.2.1 Commerce

This section describes existing conditions for regional economic activities that could be affected by implementation of any of the Policy Directions

Power and Transmission

In the Pacific Northwest, the total firm energy resources are about 21,000 aMW.[101] Major power resources include hydro (55%), coal (19%), and nuclear (5%), totaling about 80 percent of the Region's power resources. Almost 10 percent of the Region's energy needs are met by importing power from other regions. The Columbia River and its tributaries are extensively developed for hydroelectric power, with more than 250 Federal and non-federal dams constructed since the 1930s. The current trend in energy development shows growth in the number of CTs being constructed (see Appendix E). However, the Region has also seen an increase in renewable energy development, especially wind.

The Bonneville Power Administration is a self-funding Federal agency, under the U.S. Department of Energy, that markets wholesale electrical power and operates and markets transmission services in the Pacific Northwest. It pays for its costs through power and transmission sales. Both power and transmission are sold at cost, and BPA repays any borrowing from the U.S. Treasury with interest.

The power comes from 31 Federal hydro projects—operated by the Corps or the Bureau, one non-federal nuclear plant and several other non-federal power plants. The hydro projects and the electrical system are known as the Federal Columbia River Power System (FCRPS). Figure 2.14 and Appendix E shows the major hydro sites in the Region. About 45 percent of the electric power used in the Northwest comes from BPA. Figure 2.2 shows BPA's service territory.

[101] See Figure 2-5.

BPA's transmission system, known as the Federal Columbia River Transmission System (FCRTS), accounts for about three-quarters of the region's high-voltage grid, and includes major transmission links with other regions. The FCRTS is comprised of approximately 15,000 miles of high voltage transmission lines, 285 substations, and other related facilities. Included in this system is BPA's portion of the Pacific Northwest/Pacific Southwest Intertie (PNW/PSW Intertie), which has a combined north-south capacity, on five high voltage lines, of about 4,800 MW (the normal capacity is somewhat less south-north—3,675 MW). BPA owns about 80 percent of the portions of the Intertie located north of California and Nevada. The PNW/PSW Intertie provides the primary bulk transmission link between the two regions. BPA's transmission system also includes interconnection with British Columbia (BC), Canada, at the international border. These lines, which comprise the Northern Intertie, have a total north-south transfer capability of 3,150 MW (2,000 MW south-north). These interconnections allow the PNW and BC to undertake many mutually beneficial arrangements. BPA uses its transmission system to deliver power to its customers and makes excess capacity available to others. Transmission system maintenance is a critical component of maintaining capacity and reliability of the power grid.

BPA's customers include its "preference" customers (publicly owned utilities), investor-owned utilities, Federal agencies, and direct service industry customers (primarily aluminum smelters). Under a Residential Energy Exchange mechanism BPA equalizes, at the wholesale level, the rate paid by residential and small farm customers of investor-owned utilities with rates charged the publicly-owned utilities. BPA also sells or exchanges power with utilities in Canada and the western United States taking advantage of differences in power costs and timing of demand. Revenues BPA earns help it fulfill public responsibilities that include low-cost and reliable power and investments in energy conservation and renewable resources. BPA also funds the region's efforts to protect and rebuild fish and wildlife populations in the Columbia River Basin.[102]

The sustained peak capacity of the Federal-based system is approximately 17,000 MW. However, the firm power capability of the FCRPS is about 8,000 aMW. In 2001, BPA's customers needed 3,000 MW beyond what the Federal-based system could provide. To serve this need BPA augmented the FCRPS with purchase power and load buy-downs. Under most conditions the generating capability of the FCRPS exceeds BPA's firm loads and any surplus power is sold. BPA's ability to forecast is often hampered by tremendous uncertainty as a result of the volatility of the electricity prices and the huge year-to-year swings in runoff on the Columbia River. See Table 5.1-3 for information concerning BPA power resources.

[102] In 2000 BPA became the marketing agent for the Bureau of Reclamation's Green Springs project in southern Oregon—outside the Columbia Basin. BPA has no Regional Act mitigation responsibilities for that project.

Table 5.1-3: BPA Power Resources for Calendar Year 2002

Sustained peak capacity	**17,462 MW**
hydro: 13,898 MW (80%)	
nuclear: 915 MW (5%)	
firm contracts & other resources: 2,649 MW (15%)	
Firm energy (12-month average)	**9,871 aMW**
hydro: 6,647 aMW (67%)	
nuclear: 972 aMW (10%)	
firm contracts & other resources: 2253 aMW (23%)	

The surplus sales are an important source of revenue and help keep BPA's rates down. BPA sells its surplus energy to a variety of customers, including investor-owned utilities, power marketers, and other public agencies. Sales to California, which often has higher electricity prices than the Pacific Northwest, are also an important source of revenue.

Recently, electricity demand has increased faster than supply in the western United States. Demand has increased with population growth and adoption of computer technologies, but supply development has been constrained by environmental regulations and uncertainty about market structure and prices. As a consequence, regional power generation capacity is less able to meet demand in peak demand periods, and more frequent shortages appear likely in the future. Rolling blackouts have occurred in California. The responsibilities of the FCRPS in exporting electricity and in protecting fish and wildlife came into sharp conflict during the summer of 2000, when fish spill was decreased to generate more power for export.

In addition, the winter of 2000 – 2001 saw natural gas prices reached record levels. These events increased the value of hydropower generation significantly. Electricity spot prices reached unprecedented levels, and California's electricity market deregulation faced close scrutiny by Federal and state regulators. Electricity prices under these circumstances are likely to remain high, and shortages likely to be more frequent, until the new generation capacity is developed at a rate that meets or exceeds demand growth. Natural gas consumption by power plants is expected to more than double in the region by 2010.[103]

This situation continued to deteriorate in the summer of 2001. The winter of 2000-2001 was one of the driest on record since 1929. A lack of water supply forced Federal agencies to transport up to 90% of Snake River anadromous fish migrants, and the agencies were unable to provide normal system benefits for users through most of 2001. For BPA, this situation means that it will be more difficult to provide low-cost power and protect fish and wildlife as in normal years.

[103] State of Washington 2001, p. 14.

Transportation

The Columbia-Snake River Inland Waterway is a 465-mile-long water highway formed by the eight mainstem dams and lock facilities on the lower Columbia and Snake rivers. The waterway provides inland waterborne navigation up and down the rivers from Lewiston, Idaho, to the Pacific Ocean. This system is used for commodity shipments from inland areas of the Northwest and as far away as North Dakota. The navigation system consists of two segments: the downriver portion, which provides a deep-draft shipping channel, and the upriver portion, which is a shallow-draft channel with a series of navigation locks. The four lower Snake dams account for 140 miles of the waterway. This upper reach is maintained at a depth of 14 feet. Commercial shallow-draft traffic on the Snake River is primarily by barge or tow boat.

The Corps maintains the navigation channel in the Columbia and Snake rivers from the estuary to Lewiston, Idaho. The Corps uses dredging and other methods to maintain the shipping channel, and is proposing a navigation channel-deepening project.[104] There are potential substantial adverse effects resulting from this action: for example, the creation of dredge spoils islands where Caspian terns and other birds nest. These birds prey on juvenile salmon. NMFS and USFWS are presently in consultation with the Corps on deepening the navigation channel by dredging it from 40 to 43 feet deep.

The presence of the Columbia-Snake River Inland Waterway has led to the development of a sizable river-based transportation industry in the Region. The Waterway has 36 deep and shallow water ports. Riverside facilities managed by port districts and various other public and private entities are located next to the pools created by the system of dams and locks.

A few companies account for the majority of vessels operated, as well as the majority of traffic. Total annual shipments using any part of the lower Snake system recently weighed about 4 million tons. Upriver tonnage is about one-tenth the downriver amount. About three-quarters of the cargo are wheat and barley. Most of the remaining downriver traffic is forestry products, and most of the upriver cargo is petroleum products and chemicals. Rail and road transport would not be able to transport commodities as inexpensively as the existing water transportation system. The transportation savings have been estimated to range between $24 and $35 million annually.[105] Figure 2.16 shows the major barging routes, railroad tracks, and interstate and state highways in the Region.

Railroads provide an important mode to transport goods within the Columbia Basin. Major railroads serving the Columbia Basin include: the Burlington Northern Santa Fe Railroad (BNSF), Union Pacific Railroad, Camas Prairie Railroad, and the Montana Rail Link. Both BNSF and the nion Pacific link the Pacific Northwest to the Mid-West. The BNSF runs along the north side of the Columbia River, while the Union Pacific runs along the south side. "Both BNSF and Union Pacific provide extensive trackage in all

[104] Corps 2002a.

[105] Corps 1999c, Appendix I Economics, Table 8-1.

four states."[106] The Camas Prairie Railroad and Montana Rail Link provide local service in Idaho, Washington, and Montana.

Over the past decade, grain shipmets by rail have remained constant at the Port of Portland, and increased at the Port of Vancouver, although it has declined in the Puget Sound Area. Wheat and barley are a major portion of total grain traffic, but more than half of this grain involves corn from the Mid-West. An increasing amount of this corn moves through the Port of Kalama on the Columbia River. Grain arriving at lower Columbia River ports is unloaded from rail cars and barges and transferred to deep-water vessels for export to other markets.[107]

Trucks are also used for moving goods, particularly petroleum and chemical products. Used in conjunction with other forms of transportation (rail and barge), trucks move goods to and from lower Snake and Columbia River ports and rail depots. The highway infrastructure serving the Region includes Federal, state, and county highways. The major interstate higways are 5, 15, 84, 82, and 90. The major state highway is 395, however others include 2, 26, 93, 95, 97, and 101.

Agriculture, Ranching, and Forest Products

Agriculture, ranching, and forest products are important industries for the Pacific Northwest, especially in rural areas. Table 5.1-4 presents data on agriculture, ranching, and forestry by state for the Region. See also Figure 2.10 for a map showing general land uses across the Pacific Northwest.

Table 5.1-4: Data on Agricultural, Ranching, and Forestry by State

	Idaho	Montana	Oregon	Washington
Number of Farms, 1999	24,500	28,000	40,500	40,000
1992 Land Use, 1000 acres				
Cropland	4,799	13,941	3,720	6,500
Grassland pasture	20,219	47,364	22,456	7,590
Forestland	18,033	18,592	26,614	17,985
Irrigated Land, 1997, 1000 acres	3,494	1,994	1,949	1,705
Farm receipts, 1998, million $				
Crop receipts	1,735	934	2,330	3,424
Livestock receipts	1,585	865	762	1,730
Government payments	196	357	100	257
Total receipts, million $	3,320	1,799	3,091	5,154

Source: USDA Agricultural Statistics 2000

[106] Corps 2002b, Section 4.9.2 Railroads.

[107] Corps 2002b, Section 4.9.2 Railroads.

There are 7 to 9 million acres of irrigated land in the Columbia River Basin used for both agriculture and grazing. Major agricultural products include alfalfa and other hay, wheat, corn, potatoes, peas, apples, grapes. Agriculture is still the second largest industry in Washington. The food-production industry, combined with agricultural production, is the largest employer in Washington.[108] Irrigation water use tends to be focused in areas with suitable land and climate. The share of Columbia Basin water diverted for irrigation is small (about 6%), but the share of water diverted from some sub-basins is much larger. Important irrigated areas include the Upper Snake River, the Columbia Basin Project, and irrigation from the Yakima, Willamette, Deschutes, and John Day rivers.

Some irrigated areas depend on water levels in Federal reservoirs for irrigation diversions. For example, the reservoir behind the Grand Coulee Dam irrigates over 500,000 acres. Other mainstem reservoirs are also important for irrigation. About 167,000 and 125,000 acres are irrigated from John Day and McNary reservoirs, respectively. More than 300,000 acres of irrigated land are served out of the lower Snake reservoirs.[109] About 37,000 acres from Ice Harbor alone, are irrigated using surface water diverted. In addition, many wells benefit from the raised groundwater levels caused by reservoir storage nearby.

There are also about 16 million acres of dry (non-irrigated) agricultural land in the Basin.[110] However, less than 10 million acres is normally planted in dryland crops at any given time. Dryland crops are primarily small grains such as wheat or barley, beans, and some hay. Value of production per acre is typically half or less of irrigated values. Dryland crops are scattered throughout the Basin with notable concentrations in eastern Washington and Oregon and the Snake River plain.

There are approximately 45 million acres of rangelands in the Basin, of which about 25 million acres are Federal lands.[111] Additional grazing occurs on some forestlands, mostly on the eastside of the Cascades. Most Federal rangelands are managed by BLM and the USFS, with some grazing use on Indian reservations. Most grazing use is for cattle, although sheep and horses are also grazed. Management and characteristics of the Federal grazing lands in the Basin east of the Cascades are described in detail in the ICBEMP Supplemental Draft EIS.[112]

There are about 65 million acres of forestlands in the Basin, of which 42 million acres are Federal. Most Federal forestlands are managed by the USFS, although large amounts of forestland are also managed by BLM, NPS, and other Federal agencies. Management and characteristics of the Federal forestlands in the Basin east of the Cascades are described in detail in the ICBEMP Final EIS (2000). Timber harvest on Federal

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[108] Hertha Lund, Washington Farm Bureau. Comment letter submitted with respect to the DEIS. See Appendix K of this EIS.

[109] Corps 2002b, Section 4.11.1 Irrigated Agriculture.

[110] Land use information is from Council 2000a, Section 4.

[111] Land use information is from Council 2000a.

[112] USDA/USFS and USDOI/BLM 2000a.

forestlands has declined in recent years. Most timber harvest is occurring on private forestlands. See Figure 2.13 for the different land ownership across the Region.

Declining and less predictable Federal timber availability, along with technological and other changes in the forest products industry, have affected the industry. Lack of timber availability has resulted from two major factors: (1) actual reductions in the amount of timber caused by declining forest health; and (2) the challenges and complexities of meeting current regulations and policies in relation to broader issues such as ecosystem health, declines in anadromous fish runs, and concerns for the health of other plant and animal species. These effects have contributed to decreasing employment opportunities for forest products; those decreases in turn have contributed to economic and social hardships in communities highly dependent on Federal timber. Declining timber availability has affected people directly through job losses and indirectly through effects on Federal government revenue sharing, with reduced funds for schools and roads.[113]

The rural way-of-life became the focus of intense public debate as timber-dependent communities suffered job losses in the traditional lumber and wood products industries. Rural areas also experienced declines in the agriculture and food-processing industries, caused by efficiency and productivity gains. Many rural areas are located away from a well-developed infrastructure, face serious periodic economic downturns, and pose significant challenges for economic and social policy. Rural areas continue to lose their economic base because of resource depletion, land use and environmental laws, and changes in markets and technology. Low-cost energy and transportation have helped sustain agriculture and forestry in rural areas.

Commercial Fishing

Potentially affected commercial fisheries are primarily salmon fisheries, both in-river and ocean. The in-river fisheries include the Columbia and Snake River system. Columbia Basin salmon are also harvested off the coast of the northwestern U.S., Canada, and Alaska. Salmon range up and down the coast in what is defined as a mixed-stock fishery, with increases in harvest levels only when abundance is high. Total economic consequences (personal income including multiplier effects) of the Columbia River commercial fishery under early 1990s conditions have been estimated to be about $33 million.[114] Decreased fish abundance in recent years (and therefore declines in harvest) has reduced the present value of the commercial fishing industry.

Columbia River salmon are caught by ocean commercial net and troll fisheries from California to Alaska. The ocean fisheries also catch salmon from many non-Columbia River stocks. Ocean fisheries are very difficult to manage: the life history of salmon (e.g., migratory patterns and natural population levels); multiple jurisdictions, laws, and treaties involved; and the natural mixing of salmon populations from different freshwater

[113] USDA/USFS and USDOI/BLM 2000a, Chapter 2 p. 184.

[114] Derived from information in Corps 1999a.

origins all need to be considered.[115] The freshwater commercial fishery of the Columbia River system includes in-river sport charter boats, the non-Indian gillnet fishery (operating in the zone from the estuary to Bonneville Dam), and the treaty Indian gillnet fishery (operating in the mainstem Columbia River between Bonneville Dam and McNary Dam).[116] While in the river, the fishery is subject to Federal, state and tribal jurisdictions, laws (e.g., ESA), treaties, and management strategies. Run size, catch and income vary from year to year, but gross annual value of the in-river fishery has been estimated to be about $15 million.

Harvest seasons and catch have been reduced compared to historical levels. For example, the commercial and sport harvest of chinook salmon off the Washington and northern Oregon coasts has declined from nearly 600,000 fish in 1974 to an average of about 15,000 fish since 1994.[117] There also have been similar declines evidenced in the commercial river harvest.[118] The general decline of wild salmon stocks had resulted in no commercial in-river spring chinook fishery since 1977. However in 2000, in-river commercial harvest of adult spring Chinook resumed. There has also not been an official commercial fishery for summer chinook since 1967, although summer chinook were incidentally harvested during the sockeye salmon harvest until about 1973.[119]

Harvest strategies to date have been focused on reducing overall effort. There has been a trend to reduce harvest rates in mixed-stock areas in favor of harvests in more terminal areas where the stocks can be segregated and more selectively caught.[120] Strategies to implement terminal fisheries or other targeted harvest approaches are still under development. Also, hatcheries have been operated to support anadromous fish populations for harvest. Changes in harvest regulations have been in the form of restrictions, shortened seasons, area closures, special gear regulations, license moratoria, and buyouts of fishing fleets.

The lack of coordinated management across jurisdictions, combined with competitive economic pressures to increase harvest or to sustain them in periods of lower production, resulted in harvests that were too high and escapements that were too low. At the same time, habitat had been increasingly degraded, reducing the capacity of the salmon stocks to produce numbers in excess of their spawning escapement requirements.[121] In 1999, the United States and Canada signed the Pacific Salmon Treaty, focusing on a cooperative, conservation-based approach that results in more equitable sharing of salmon catches between Canada and the United States.[122]

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[115] Federal Caucus 1999b, Harvest Appendix, p.6.

[116] Federal Caucus 1999b, Harvest Appendix, p.5.

[117] Federal Caucus 1999b, Harvest Appendix, p.8.

[118] Federal Caucus 1999b, Harvest Appendix, p.8.

[119] Federal Caucus 1999b, Harvest Appendix, p.8.

[120] Federal Caucus 1999b, Harvest Appendix, p.7.

[121] NMFS 2000b, Chapter 5.

[122] The Pacific Salmon Commission 1999.

Other Industry

The regional economy has experienced some transition over the last decade or so, evolving from being primarily natural resource-based to a diverse economy with growing trade and service sectors. The largest industry sectors (and their relative contributions to the regional employment) include services (25.0%); trade (21.1%); government (16.4%); manufacturing (11.7%); fire, insurance and real estate (6.0%); and construction (4.7%). Of these sectors, services show the highest economic growth, and provide the highest per-capita income. In general economic activity is greatest in metropolitan areas.

Mining is not currently a major industry in the Pacific Northwest, although historically it was a major contributor to the regional economy.[123] Mining activities have include hard-rock mineral mining, oil and gas extraction, sand and gravel mining, and recreational suction dredge, placer, and pan mining.[124] Today, sand and gravel mining account for most of the mining activity in the Region. Sand and gravel mining (consisting of deep water dredging, gravel bar scalping, and gravel pit excavation) has been important to local economies for construction.[125] Some mining is located in areas where flood activity of nearby rivers has caused huge amounts of sand and gravel to accumulate over time. Substantial areas of mineral deposits still remain for potential future exploitation.

Mining, aluminum products, and other natural-resource-based and water- and energy-dependent industries are facing increasing regulation, operational costs, and foreign competition. These factors have resulted in a general decline of these industries. In contrast, services and government sectors are increasing. The regional economy continues to grow and diversify as the human population increases. Information-based technologies and services continue to grow fastest, followed by trade, government, and manufacturing. Natural-resource-dependent industries will continue to face increasing costs and foreign competition.

5.1.2.2 Recreation

Recreation is a very important component of the economy of the Pacific Northwest. The variations in habitats and vast amounts of public lands make the region available to a wide array of recreational activities. Many of these recreational opportunities are located in rural areas removed from population centers.[126] In fact, National Forest lands in Idaho, Oregon, and Washington received, respectively, 15, 37 and 25 million visitor days in 1997.[127] Recreational activities generate revenue and support a recreation and tourism based economy in many areas. These local economies also benefit from providing recreational-related goods and services (e.g., food, lodging, supplies, gasoline).

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[123] Rost, Bob 1998. The history of mining activity and its environmental impacts in Oregon is similar to the experiences of the other Pacific Northwest states.

[124] Spence et al. 1996, Chapter 6.

[125] USDA/USFS and USDOI/BLM 2000a, Chapter 2 p. 185.

[126] Corps 2002b, Section 4.13 Recreation.

[127] USDA 2000, Table 12-38, Page XII-28.

Outdoor recreation has also become an important use of the Federal hydroelectric system, as recreational use is authorized at all of the Federal projects. Numerous reservoirs and their shorelines provide many opportunities for recreation. The Corps and Bureau are responsible for providing recreation facilities at their projects; and often these agencies cooperate with state or local governments to provide recreation facilities such as swimming beaches, boat ramps, marinas, and campgrounds. Most reservoir recreation is concentrated in the summer months. For example, annual use at the four most downstream reservoirs was recently estimated to be about 10 million days annually, with usage of all Federal reservoirs above McNary at about 8 million days annually. Annual use at the four lower Snake dams is about 2 million days. Recreation can be divided in to two main categories for the purposes of discussion: Sport Fishing and Hunting; and Other Recreation.

Sport Fishing and Hunting

The Pacific Northwest has plentiful hunting and trapping opportunities for big game (deer and elk), upland game (pheasants and rabbits), furbearers (beaver and mink) and waterfowl (ducks and geese). Opportunities for recreational fishing for resident fish (such as trout and bass), and anadromous fish (such as salmon and steelhead) are also abundant. For many decades, recreational fishing has been supported by hatchery production to help maintain available harvest levels. For the past decade there have been hundreds of thousands of hunters and anglers and millions of dollars spent annually in support of these recreational activities.[128]

Recreational fishing for salmon and other anadromous fish is an important economic activity in of the Pacific Northwest. Ocean sport fishing is also an important activity. Economic value of freshwater sport fishing for anadromous fish under the restrictive fisheries regulations of the early 1990s (compared with the 1970s - 1980s) has been estimated to be about $3 million annually. The Pacific Fisheries Management Council has estimated personal income effects of ocean sport fishing in Oregon and Washington in 1993 to be around $12.5 million annually, down from $20 million or more in the 1980s due to recent harvest restrictions to protect weak stocks of coho and chinook salmon. The value of sport harvest fluctuates according to the allowable catch, which is dictated by the abundance of fish runs and associated local harvest regulations.

Other Recreation

Other recreation includes both water-based and land-based recreational activities. Water-based recreation consists of activities such as boating, waterskiing, windsurfing, rafting, kayaking, canoeing, and swimming.[129] Many boat launch ramps, beaches, marinas, and

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[128] See websites for examples of the number of hunters and sport fishers. Oregon: http://www.dfw.state.or.us/index.html; Washington: http://www.wa.gov/wdfw/huntcorn.htm; Idaho: http://www2.state.id.us/fishgame/. Last visited January, 2003.

[129] The U.S. Department of Interior, through the National Park Service, manages a portion of Lake Roosevelt and associated lands at Lake Roosevelt National Recreation Area (LRNRA). Mr. Preston Sleeger, Regional Environmental Officer within the Agency, submitted comments detailing the specific

other facilities have been developed to support these activities. For example, there are 33 developed recreation sites on the lower Snake River reservoirs alone. These sites include 29 boat ramps with 59 launch lanes, 9 campgrounds with approximately 435 individual campsites, and 49 day-use facilities. There are also 22 access or primitive recreation areas where camping is allowed. More than 25 million people visited the John Day reservoir during a 10-year period from 1989 through 1998.[130] In 1998, the lower Snake River area at the Lower Granite Dam reservoir had more than one million visitors. Even the the least-visited reservoir behind Lower Monumental Dam had more than 157,000 visitors.[131] Land-based activities such as picnicking, camping, mounatain biking, horseback riding, wildlife viewing (a non-consumptive use of widlife), hiking, skiing, and ecotourism are also popular throughout the Region.[132] These activities are supported by miles of trails and roads, as well as numerous interpretive and visitor centers. "According to the Washington Department of Fish and Wildlife, wildlife watching already brings $1.7 billion into the state economy each year and creates 21,000 jobs. The potential for continued economic growth—and conservation—is enormous."[133]

5.1.2.3 Economic Development

Industrial, Residential, and Commercial Development

Industrial, residential, and commercial development are important economic activities in the Basin. Between 1990 and 2000, the Region experienced about a 21% growth in population.[134] This growth has fueled the development in the industrial, residential, and commercial sectors. There are about 1.5 million acres of urban lands in the Basin. Almost half of this amount (600,000 acres) is concentrated in the Lower Columbia River area. See Figure 2.12, which shows the counties by distribution of population. Table 5.1-5 summarizes some data on value of construction, and home construction and sales specific to residential development in the Region.

Table 5.1-5: Data on Value of Construction, Housing Units and Existing Home Sales by State

	Idaho	Montana	Oregon	Washington
Construction Contracts, million $, 1998	2,015	935	5,046	8,431
1000s Private Housing Units Authorized, 1998	11.7	2.6	25.9	45.7
Existing home sales, 1000s, 1998	29.7	18.3	63.1	159.2

Source: USDC, Statistical Abstract of the United States, 1999

impacts to recreational use and facilities at the LRNRA under certain circumstances. This information is located in Appendix K of this EIS.

[130] Corps 2000, Section 10.2.3.2 Existing Recreation Use and Value.

[131] Corps 2002b Section 4.13.1.2 Visitation.

[132] Corps 2002b Section 4.13.1 Recreation and Table 4.13-2.

[133] Mlodinow, S. 2002.

[134] Data taken from US Census Bureau, http://www.census.gov (Idaho: http://quickfacts.census.gov/qfd/states/16000.html; Montana: http://quickfacts.census.gov/qfd/states/30000.html; Oregon: http://quickfacts.census.gov/qfd/states/41000.html; Washington: http://quickfacts.census.gov/qfd/states/53000.html (last visited January, 2003).

Major urban areas have undergone significant growth in high-tech industries and corresponding economic development, while rural areas continue to rely on traditional industries experiencing little economic growth.[135] Industrial, residential, and commercial development is largely market-driven. However, water availability and many land use and environmental laws and regulations have shaped development. For example, the ESA, as well as state-sanctioned or mandated programs, has had some influence in plan development in special-status species habitat. In fact over the past decade, the uses of habitat conservation plans have become more common.

Employment and the Regional Economy

Employment in the Pacific Northwest has undergone substantial change over the past three decades. Generally, the economy of the Basin is evolving away from its current level of dependence on agriculture, range, and timber, toward trade and services, including information-based technologies. Total employment in the four-state region was recently about 5.5 million persons. Services, trade, and government activities accounted for most regional employment and the shares of employment in these sectors have been growing for the last few decades.[136] The services, retail trade, and government sectors were the largest employers in 1998. These changes broadly reflected changes in the United States economy where employment in the farm and manufacturing sectors has declined, and the largest increases have been in the services and retail trade sectors. In 1996, the employment mix for some of the key job areas in the region was about 3% farming, 2% forestry/fishing/farm services, 18% construction/manufacturing, and 5% transportation/utilities. In 1997, agriculture, forestry, fisheries, lumber, paper, mining, and electric and gas utilities accounted for less than 10% of employment.[137]

Employment in Washington, Oregon, and Idaho increased in most sectors from 1969 to 1998, but the *percent* relative to the total regional employment declined for farming (from 6% to 3%), manufacturing (from 19% to 12%), and transportation (from 5% to 4%), while it increased from 1% to 2% for agriculture (other than farming), forestry, and fishing; and construction from 5% to 6%.[138] Employment in the services sector increased from 17% to 29%, while retail trade employment increased from 15 % to 17%.[139] These increases were at a faster rate than the national average. Recently a downturn in the economy, resulting in the Pacific Northwest having some of the highest unemployment rates in the country, has slowed regional economic growth.

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[135] Corps 2000, Section 10.4.3 Study Area Overview.

[136] Council 2000a, Section 3.2.4.1 Current Regional Economic Conditions; and Quigley, T.M. and S.J. Arbelbide 1997.

[137] Extracted from Council 2000a, Appendix A, Table A-1.

[138] Corps 2002b, Section 4.14.1.1 Employment.

[139] Corps 2002b, Section 4.14.1.1 Employment.

5.1.2.4 Funding Costs

For a complete discussion of funding costs, both from ratepayers and other sources, please see Section 2.3.2.3 Current Policies—Conflicting Priorities: Managing the Money Resource. See also Appendix H for a detailed list of BPA fish and wildlife projects.

5.1.2.5 Tribal Interests

The federally recognized Indian tribes of the Columbia River Basin encompass many different cultures, habits, geographic locations, and relationships to natural resources. While there are over 50 tribes in BPA's service area, BPA works with the 13 tribes[140] of the Columbia River Basin, the area within which most of BPA's mitigation and recovery actions for the FCRPS are implemented. Four of the thirteen tribes have adjudicated treaty fishing rights on the lower Columbia River —the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Nez Perce Tribe of Idaho, and the Yakama Nation. The other nine tribes also have fishing and hunting rights. These tribes include the Burns Paiute Tribe of the Burns Paiute Indian Colony, Coeur d'Alene Tribe, Confederated Salish and Kootenai Tribes of the Flathead Nation, Shoshone-Bannock Tribes of the Fort Hall Reservation, Shoshone-Paiute Tribes of the Duck Valley Reservation, Kalispel Indian Community of the Kalispel Reservation, Kootenai Tribe of Idaho, Spokane Tribe of the Spokane Reservation, and the Northwestern Band of the Shoshoni Nation. A non-federally recognized Native American Indian community likely to be affected is the Wanapum Indian Community.[141] Each of these tribes is unique. However, many tribes share common bloodlines, traditions, religious practices, and languages. Figure 2.13 shows a map of the Indian Reservation lands and other land ownership in the region today.

Native American cultures within the Pacific Northwest developed over thousands of years. By the early 19th century, Native American Indians had developed different languages and dialects. They had also adapted in a variety of ways to living in the unique environments of the Pacific Northwest. The region's abundant natural resources supported their subsistence-based economies. Established trade, political and social networks, and other alliances connected the region's different cultures.

As tribes were federally recognized and moved to reservations in the mid-19th century, many different bands were forced to live together on reservation lands often located away from their traditional lands. Throughout the 19th and 20th centuries, their tradtional way of life was further threatened by increasing pressure to assimilate into the non-Indian culture. Restrictions were placed on traditional, cultural, and religious practices, such as harvesting foods and medicines, observing religious practices and ceremonies, speaking native language dialects, and living in extended families.

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[140] The Cowlitz Tribe has recently been federally recognized, but are not yet very active in mitigation efforts. The 50 tribes are named in Appendix B: Mission Statements and Statutory Tables.

[141] For more information on the individual tribes please see Corps 2002b, Section 4.8.1.1 Tribal Summaries.

Many Native American Indians continue to live on or near Reservation lands. The tribes exercise sovereign governmental authority over tribal members and land on their respective reservations. Their tribal governments remain their primary form of representation in family and community life. Northwest Indians also hold and exercise rights to important activities and resources in areas beyond their respective reservation boundaries. These off-reservation rights typically include fishing, hunting, gathering activities, and use of sacred and religious sites. Through their reserved treaty fishing rights, Northwest tribes have access to their usual and accustomed places along the riverbanks during the fishing season. As the dams were constructed in the lower Columbia River, many of the usual and accustomed fishing sites were flooded. Congress provided compensation for this loss, both monetary and in the form of in-lieu fishing sites.

Numerous fish, wildlife, and plant species—salmonids, lamprey, sturgeon, whitefish, sculpin, deer, cous, Indian carrots, chokecherries, and tules—retain cultural significance to American Indian tribes. Salmon are a major food source and trading commodity for most Columbia Basin tribes. Pacific Northwest Indians revere salmon, including steelhead, as "divinely-provided traditional food," and "as … designated lead fish essential on the tables at community dinners."[142] "A large catch of fish (enough to both sell and give away) brings social esteem to both the fisherman and the skilled salmon handlers who prepare and serve the catch."[143] However, due to settlement and development of the Basin by non-Indians over the last century, as well as climatic changes, there has been a dramatic decline in the amount of salmon harvested and consumed by tribal peoples.

The loss of salmon has altered traditional tribal economies, and reduced wealth, health, and well being. Today, to the relatively limited extent the resource permits, tribal people continue to fish for ceremonial, subsistence, and commercial purposes employing—as they always have—a variety of technologies. Tribal members fish from wooden scaffolds and from boats; they use set nets, spears, dip nets, and poles and lines. The tribes still maintain a dietary preference for salmon, and its role in ceremonial life remains preeminent. Salmon are important and necessary for physical health and for spiritual well-being. Today, perhaps even more than in the past, the Columbia River treaty tribes are brought together by the struggle to save their fishing rights and by shared spiritual traditions such as the first salmon feast.

Some other tribes in the Basin have slightly different priorities. Some "upriver" tribes today have less ability to harvest salmon than they once did. They focus on resident fish and wildlife. These upriver tribes are concerned that downriver operations for salmon are harmful to upriver resident fish species.

Alongside fish, wildlife have also played an important role historically in tribal life. Today, tribes continue to exercise their rights to harvest wildlife on both their

[142] Corps 2002b, Appendix N.

[143] Corps 2002b, Appendix N.

reservations and ceded lands for ceremonial and subsistence use. For most tribes, deer and elk are the primary species for subsistence use. Other species, such as small game and fowl, are pursued depending upon tribal tradition, individual need, and opportunity. Tribal hunters tend toward modern means of harvest using firearms.

Wildlife populations have generally tended to decline as a result of non-Indian settlement and development that reduced both habitat quantity and quality. With settlement also came increased wildlife diseases and hunting. Disease affected some species, such as big horn sheep, drastically. Unregulated hunting resulted in other species, such as pronghorn and moose, becoming much rarer. Targeted extermination practically eliminated other species, such as grizzly bears and gray wolves, from the Region. Not all species, however, have necessarily declined, and members of some tribes have begun to shift their harvest activities accordingly.

Socioeconomic conditions for tribal members are not on par with their non-Indian neighbors, as tribal members cope with high poverty, unemployment, and death rates. The depressed tribal economies are principally caused by declines in tribal fisheries and the loss of tribal lands. Table 5.1-6 shows these rates and the per-capita income for the four states and selected tribes in the Columbia Basin.

With the decline of fish and wildlife resources, many of the Northwest tribes have focused on other economic enterprises. Many have developed recreation and tourism industries that include camping and other outdoor recreation like golf; large resorts and hotels; and cultural centers and museums. Some have created opportunities for non-Indians to hunt and fish on reservation lands, and have also recently exerted strong leadership roles in natural resource preservation and management, as well as in the protection of cultural resources. Several tribes have constructed large casinos, which generate large sums of money for tribal members. Much of the development on the reservation are done through tribal construction and engineering firms. There has also been a recent push for power generation development to serve the reservations. Many of the tribes continue to be involved in agriculture, ranching and the forest products industry. All of these enterprises will likely play an increasingly important role in improving the socioeconomic condition for many tribal members.

Tribal water rights may play a significant role in tribal economies in the future. Reservations typically include express or implied water rights sufficient to fulfill the purposes of the reservation. More often than not, a tribe's reserved water rights will be senior to other rights in a watershed. Through basinwide adjudications, such as those for the Yakima and Snake rivers, tribal water rights are being quantified, thus allowing tribes greater freedom to use or market their water. As tribes exercise their historic rights, the large blocks of water they control may play a major role in shaping future development and fish and wildlife mitigation and recovery actions.

Table 5.1-6: Poverty Rates, Unemployment Rates, Per Capita Income and Mortality Rates for All Citizens, including Tribal Citizens, of the Columbia Basin

States/Tribes	Poverty (Percent)	Unemployment[1] (Percent)	Per Capita Income[2]	Rate of Death (per 100,000 population)	Ratio of Tribal Death Rate to State Death Rate
Washington	10.9	5.7	$13,400	477.1	
Yakama	42.8	23.4	$5,700	965.8	2.0
Colville	28.9	20.2	$8,000	823.5	1.7
Spokane	33.0	17.3	$7,800	557.0	1.2
Kalispel	31.4	13.5	$7,800		
Oregon	12.4	6.2	$14,900	487.2	
Umatilla	26.9	20.4	$7,900	491.1	1.0
Warm Springs	32.7	19.3	$4,300	721.4	1.5
Burns Paiute	42.8	50.0	$4,600	*	*
Idaho	9.7	6.1	$11,500	440.4	
Kootenai	28.1	30.3	$8,300	**	**
Coeur d'Alene	27.7	17.8	$6,100	519.6	1.2
Nez Perce	29.4	19.8	$8,700	628.0	1.4
Shoshone-Bannock	43.8	26.5	$4,600	1,033.7	2.3
Shoshone-Paiute[3]	44.2	25.2	$5,200	***	***
Montana	16.1	--	$11,200		
Flathead Salish and Kootenai	27.4	16.4	$8,800		

[1] In winter, tribal unemployment can reach 80%.
[2] Includes Duck Valley Sho-pai in Nevada.
[3] Census data is before income taxes, after transfers
* Data included in Warm Springs Indian Health Service Unit.
** Data included in Indian Health Service Unit serving Nez Perce.
*** Data not separately available.
Note: This table includes data on the 13 Federally recognized tribes, as of Fall 2000.
Sources: Council, 2000a: Human Effects Analysis, 2000, as summarized from U.S. Bureau of the Census, 1990, Portland Area Indian Health Service, 1994. American Indian and Alaska Native Mortality: Idaho, Oregon and Washington, 1989-1991, Census of Population Social and Economic Characteristics American Indian and Alaska Native Areas. 1990 CP-2-1A

The sovereign status of Indian tribes has long been recognized. Principles outlined in the Constitution, treaties, Executive Orders, statutes, regulations, and Federal court jurisprudence continue to guide national policy towards Indian nations. Working within a government-to-government relationship with Federally recognized Indian tribes, BPA consults with the tribal governements to assure that tribal rights and concerns are considered prior to BPA taking actions, making decisions, or implementing programs that may affect tribal resources. BPA fully respects tribal law and recognizes tribal governments as sovereigns, with rights to set their own priorities, develop and manage

tribal resources, and be involved through the consultation process in Federal decisions or activities which have the potential to affect these rights.[144]

Native American Indians have been substantially affected by the loss of salmon and the declines of many game and plant species on which tribes depended. The ability of the Federal government to meet trust responsibilities as it pertains to fish harvest may be limited by the diminished resident and anadromous fish populations.[145] Most of the upriver anadromous fish opportunities have been lost. In the process of complying with the ESA, the Federal agencies have implemented actions specifically designed to benefit listed species, including salmon. This focus is consistent with treaty and trust responsibilities. Historically, there were assurances of mitigation that Congress either did not authorize or appropriate as anticipated by the tribes. As a result, many tribal members may be skeptical of mitigation and recovery promises. The increasing number and complexity of decisionmaking processes for fish and wildlife mitigation and recovery has further disenfranchised tribes as resource co-managers and sovereign entities. Many tribes have had to deplete their tribal economic and staff resources as they try to maintain presence in the numerous processes. Yet many of the processes address decisions that are critical to the tribes, such as competing resource uses. The results of decisions made in these processes could change tribal harvest, traditional practices, and the socioeconomic condition of Native American Indians. With the shrinking of tribally influenced areas and over-extension of tribal government, Native American Indian culture, especially traditional knowledge and practices pertaining to natural resource management, may also be further fragmented and lost.

5.1.2.6 Cultural and Historic Resources

Federal agency responsibilities regarding cultural and historic resources are defined by law, primarily the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act (ARPA), Native American Graves Protection and Repatriation Act (NAGPRA) and American Indian Religious Freedom Act (AIRFA). Generally, these acts protect prehistoric, historic, and cultural resources from actions that would otherwise damage them. Some of the acts also ensure access to sites, especially those of cultural or spiritual value.

Archaeological sites in the Pacific Northwest are typically represented by open campsites; pit-house (semi-subterranean dwellings) villages; rock shelters; pottery; rock art (petroglyphs/ pictographs); lithic (stone) quarries and workshops; burial grounds and cemeteries; and isolated rock cairns, pits, and alignments. In order to gain protection under the ARPA, archaeological sites must be over 100 years old. Historic resources are broadly defined to include "any prehistoric or historic district, site, building, structure, or object included in or eligible for the National Register of Historic Places."[146] These resources must usually be over fifty years old to be eligible for inclusion in the Register.

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[144] See Chapter 2 of this EIS for a discussion of BPA's Tribal Policy.

[145] USDOE/BPA, Corps and Bureau 1995, Section 4.3, p. 4-206.

[146] National Historic Preservation Act. Section 106 Regulations, 36 CFR Sec. 800.16 Definitions.

In the Pacific Northwest, historic resources can include the remains of farms, towns, trading posts, villages, mining sites, military forts, burial sites, abandoned settlements, and transportation and industrial facilities. The historic property or resource may include artifacts, records, and material, or any other remains related to the property or resource.[147] Historic resources also include properties of religious and cultural importance to Native American Indian tribes. Sites that are potentially eligible for the National Register of Historic Places, but which have not been evaluated as to eligibility, are still protected under the NHPA.

American Indians recognize archaeological and historic sites as important resources; however, they also emphasize their interests in traditional cultural properties. Native American Indians view their entire heritage, including beliefs, traditions, customs, and spiritual relationships to the earth and its natural resources as sacred cultural resources. Traditional cultural properties are places and resources composed of both cultural sites and natural elements significant in contemporary, traditional, social, and religious practices, which often help preserve traditional cultural identities.

There are many cultural and historic resources within the Pacific Northwest. Many states lack accurate information about site locations, elevations, characteristics, densities, and depths of deposit; the location of many resources are unrecorded. Around the hydropower system, there is evidence that both archaeological and historic sites are more numerous, generally larger, and more complex, along the former riverbanks.[148] The losses of cultural and historic resources in the region have been extensive. Many sites have been inundated by reservoirs or covered by sediment as a result of the construction of the FCRPS. Losses involve social and cultural resources and include some of the remaining, permanently and intermittently occupied settlements and places where ceremonial traditions were practiced.[149] The major impacts on cultural and historic resources are from high water flows, wave action, and human activities (e.g., vandalism).[150] Also, unrecorded sites are exposed as a result of ongoing operations at hydro projects.[151]

Current efforts related to cultural and historic resources include funding of resource mitigation, and recording of Traditional Cultural Properties, oral histories, and place names. Recorded sites continue to be formally evaluated for inclusion in the National Register of Historic Places.[152] Local, state, and Federal regulations for cultural and historic resources provide some further protection. Even with this protection, additional losses of historic and cultural resources continue to occur. These losses can result from residential, commercial, and industrial development; and recreational activities.

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[147] Definitions adapted from Governors, Pacific Northwest States 2000. Recommendation for the Protection and Restoration of Fish in the Columbia River Basin.

[148] Corps 2000, Section 4.20, p. 53.

[149] Corps 2000, Section 4.20.6, p. 56.

[150] Corps 2002b, Appendix N.

[151] Corps 2000, Section 4.20 Cultural Resources.

[152] Corps 2000, Section 4.20 Cultural Resources.

5.1.2.7 Aesthetics

The Pacific Northwest is world-renowned for its aesthetic resources. Oftentimes, aesthetics is described in terms of scenery, however, sounds and smells are also aesthetic parameters. Scenery is the product of both natural processes and human culture, combined in various proportions that change over time.[153] Aesthetics is a value judgment: an attribute that someone finds aesthetically pleasing may be displeasing to someone else. What people find aesthetically pleasing can also vary over time. Many people value undisturbed land, air, and water while others prefer developed landscapes. Landscape aesthetics, including viewing scenery, is an important concern for nearly 20% of the region's population.[154] Aesthetics is also important to the ever-increasing number of visitors and the economies that depend on them. Approximately 26% of the landscape has been transformed by humans to the degree that the overall images are no longer near natural in appearance, but are culturally dominated.[155]

Public demand for good visibility is high. The vast majority of landscape settings within the Pacific Northwest have excellent air quality.[156] However, monitoring data from the U.S. Forest Service and National Park Service indicate that some Class I areas (as defined under the Clean Air Act) are impaired.[157] There are also increasing concerns about regional haze, especially in the Columbia River Gorge National Scenic Area.

The diverse landscape of the Columbia River Basin provides a variety of scenic attractions. Mountain landforms in the Cascades and the Northern Rockies are extensive and include massive volcanic cones, nonvolcanic snowcapped peaks, and forested ridges. The interior of the Basin is dominated by plateau-type landforms and greener stream valleys. Water features vary within and between these types of terrain. The mountain areas offer numerous lakes, glaciers, high-gradient streams, and waterfalls. Streams and lakes are less numerous in the dry interior, but the water bodies that are present tend to be visually prominent.

Water quality parameters with an aesthetic impact include odor, color, turbidity, oil and grease slicks, foam, litter and other debris, algae, aquatic weeds, and dead fish. The general appearance of a water body is an important factor in its acceptance for recreational use; these parameters are closely related to demand for recreation.

5.2 GENERIC ENVIRONMENTAL EFFECTS

The objective of Section 5.2 is to set the stage for the detailed analysis in 5.3 of the environmental consequences from implementing the alternative policy directions. This

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[153] Eckbo, G. 1969.

[154] Eckbo, G. 1969.

[155] USDA/USFS and USDOI/BLM 1997b, p. 1960.

[156] USDA/USFS and USDOI/BLM 1997b, p. 1964.

[157] USDOE/BPA 2002f, Section 3.17 Cumulative Effects.

section describes broad categories of actions taken for fish and wildlife mitigation and recovery and the generic effects of these actions on the natural, economic, and social environments.

5.2.1 Understanding Generic Environmental Effects

This subsection describes categories of implementation actions, types of environmental effects, defines common terms, and outlines generic environmental effects and potential mitigation.

5.2.1.1 Categories of Actions

Implementation actions for fish and wildlife are commonly sorted into four categories:

- *habitat* (the environment in which fish and wildlife live),
- *harvest* (commercial, sport, or other take of fish and wildlife),
- *hatcheries* (artificial production of fish), and
- *hydro* (actions involving operations or changes to dams or other water control facilities).

These four "Hs" have become the commonly accepted categories for fish and wildlife mitigation and recovery efforts under any Policy Direction.

- **Habitat.** Habitat actions include a large number of land and water management activities to improve survival of targeted species, such as habitat acquisition, habitat enhancement, and predator and introduced species control. Actions include *passive* restoration, by allowing natural regeneration, and *active* restoration, by physically modifying the habitat. These two types of restoration can have very different effects on the natural and socioeconomic environments. Often, both types of actions will be used to achieve habitat goals.

  Habitat actions are also classified according to the type of habitat affected:

  - *Uplands* are not hydrologically affected by changes to downslope aquatic bodies. Habitat actions in uplands are taken to both improve habitat quality for wildlife and reduce polluted runoff to downslope aquatic systems benefiting fish.
  - *Riparian* areas are hydrologically connected to rivers and streams by groundwater or flooding. Habitat actions in riparian areas include avoidance and removal of human disturbances, reforestation and vegetation improvements, and active physical improvements such as land shaping.
  - *Wetlands* can be seasonally or permanently wet. Habitat actions include actively creating wetlands, allowing active and passive restoration of degraded wetlands, and protecting existing wetlands.
  - *River channels and streambeds* habitat actions include active modifications such as riprap removal, addition of woody debris or spawning gravels, and dredging management.

- *Aquatic* habitat is the water environment itself. Actions can include water acquisitions for instream use and pollution control. Other actions that affect aquatic habitat are often classified as hydrosystem activities.[158]

- **Harvest.** Harvesting (taking fish or wildlife by various tribal, commercial, or recreational means) decreases abundance, which can affect the survival rates of the harvested species and/or their predators. Categories of harvest actions include ocean and river harvest reductions, shifts to terminal harvest or other more selective harvest practices, changes in harvest timing, and changes in recreational harvest, including fishing and hunting regulations.[159] For controlling unwanted predators of target species, actions include changes in recreational harvest regulations and incentives, such as bounties.

- **Hatcheries.** Hatcheries include production facilities, supplementation hatcheries,[160] genetic conservation facilities, and fish farms. Hatchery actions include closing hatcheries, building new ones, and reforming hatchery production practices. Hatcheries modify populations of targeted species by direct changes to population recruitment at specific life stages. Hatcheries may also affect naturally-spawning populations by causing interactions and competition for space, food, and reproduction with hatchery-produced fish.[161]

- **Hydro.** Hydrosystem actions include changes in operations and modifications to hydrosystem facilities. The main purpose of hydrosystem actions is to increase survival for targeted fish species by improving aquatic habitat and migration conditions. These actions include improvements in the amount and timing of flow, temperature and other water quality parameters, spill, and in-reservoir storage for resident fish. Hydrosystem actions can also include modifications to the physical hydrosystem such as dam breaching and fish passage improvements.[162] Dam breaching options can include privately-owned dams as well as the four lower Snake River dams, and the John Day and McNary dams.

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[158] For a detailed assessment of the quality and quantity of freshwater habitat in the Columbia River Basin, current management, and alternative management strategies, please see the Federal Caucus' 1999b, 2000b, and the accompanying Appendix on Habitat.

[159] For a brief history of salmon harvest in the region, current harvest management, and alternative harvest management strategies, please see the Federal Caucus' Conceptual Plan and Basinwide Strategy papers and the accompanying Appendices on Harvest (Federal Caucus 1999b, 2000b).

[160] Supplementation is an artificial propagation intended to reestablish a natural population or increase its abundance (Federal Caucus 1999b, p. 100). A conservation hatchery program, by contrast, uses artificial propagation to recover Pacific salmon by maintaining the listed species' genetic and ecological integrity (Federal Caucus 1999b, page 92).

[161] For a historical perspective on regional hatcheries, an assessment of current management, and alternative management strategies, please see the Federal Caucus' Conceptual Plan and Basinwide Strategy papers and the accompanying Appendices on Hatcheries (Federal Caucus 1999b and 2000b), as well as Brown, Bruce 1995 and Lichatowich, J. 1999.

[162] For a more detailed assessment of the effects of hydropower on listed and other species, the current management of the system, and alternative management strategies, refer to the Federal Caucus' Conceptual Plan and Basinwide Strategy papers and their accompanying Appendices on Hydropower (Federal Caucus 1999b, 2000b). USDOE/BPA, Corps, and Bureau. 1995 also provides background.

It is important to recognize that there are certain actions under each of the Hs that are likely to be impractical or infeasible for a multitude of reasons. Below are some examples of possible limits of the four "H"s.

- **Habitat**: restriction of all human access to essential habitat for fish and wildlife
- **Harvest**: ban on all harvest (commercial, recreational, tribal)
- **Hatcheries**: closure of all hatchery facilities
- **Hydro**: removal of all dams and other human-made blockages.

See Chapter 4, discussion of Reserve Options, for the more extreme applications of the four Hs above.

5.2.1.2 Categories of Environmental Effects

An implementation action is generally undertaken to address a particular need and to achieve a desired or intended outcome. That action may also have associated "side" effects: outcomes that were not the primary objective of the action, but that occur nonetheless. It is important to understand the distinction between these two types of effects before proceeding to the discussion of environmental consequences.

Intended effects are those changes to the human environment that are targeted as an implementation action, including the sequence of effects that is supposed to occur to achieve the desired outcome.

- **Example**: Water is released from one of the reservoirs to increase flow (and thus velocity) in the river. This change allows juvenile anadromous fish to move more quickly toward the ocean, increasing in-river survival. Increased survival is the intended effect.
- **Example**: A riparian area is reforested (replanting along the banks of rivers and streams) to improve streambank stability, increase shading, and contribute to in-stream woody debris. These changes reduce erosion, moderate water temperature, increase hydrologic complexity, and provide cover for fish in the stream. All of these are intended effects.

Associated effects are effects that may occur as a result of achieving the intended effects. When fish and wildlife implementation actions are taken to improve conditions for one or more species, associated environmental effects may occur for other fish and wildlife species or for humans. These effects are sometimes unwanted and undesirable.

- **Example**: Water is released from a reservoir with the intended effect of increasing flows to help juvenile anadromous fish migrate to the ocean. At the same time, this action may lower reservoir levels. The associated effects of lowering water levels in the reservoir include exposing cultural resources and decreasing resident fish habitat, and reducing navigation and recreational activities. Increasing flows may also result in the associated effects of increased levels of undesirable gas (nitrogen) supersaturation and sedimentation, including turbidity in the water downstream.

This example illustrates a fundamental concept underlying this environmental analysis: that there are many complex relationships among actions and effects. If actions taken to achieve resource improvements had only intended effects, the environmental analysis would be straightforward. However, actions often have many associated effects and the environmental analysis becomes much more complex.

There are often trade-offs among actions; and any given implementation action may have the effect of limiting the potential for other actions.

- **Example:** A dam is breached. The *intended* effect is to improve migration and survival for anadromous fish. The *associated* effect is the exposure of cultural resources and loss of resident fish habitat. The *trade-off*, however, is that the dam can no longer be used to control operations on the river. Therefore the hydro actions for fish and wildlife that could have been implemented at that dam have been eliminated. If different river flow patterns or reservoir levels are needed to facilitate fish and wildlife recovery efforts, those outcomes cannot be achieved by changing operations at the dam: the option of operating the dam is gone.

Table 5.2-1 illustrates the optimum hydro actions that would be best for different types of river uses. The optimum conditions for one resource are clearly not optimal for others. Before implementing an action to benefit one use, the trade-offs need to be considered.

Table 5.2-1: Optimum Operations Conditions for Each River Use[163]

River Use	Optimum Condition
Anadromous Fish	Streamflows as close to "natural" river conditions as possible, with mainstem reservoirs well below spillway levels
Cultural Resources	Stable reservoir elevations year-round
Flood Control	Reservoirs drafted in early spring to capture snowmelt inflows
Irrigation	Full reservoirs April through October (growing season)
Navigation	No reservoir drawdowns below minimum operating pool (MOP)
Power	Eliminate or reduce nonpower operating constraints on the system. Ramp flows up and down quickly to produce peaking power
Recreation	Full reservoirs for long summer season (May-October) and stable downstream flows
Resident Fish	Stable reservoirs year-round, with natural river flows
Water Quality	Natural river flows with minimal spill
Wildlife	Draw down reservoirs year-round to expose maximum acreage for long-term habitat recovery. Allow flows as close to natural conditions as possible

[163] USDOE/BPA, Corps, and Bureau (1995), p. 4-2. How all of these effects are taken into account in making fish and wildlife policy can be reviewed in Sections 5.2 and 5.3. Future site-specific projects will use this analysis of effects to determine each project's viability and provide specific details to where and how the effects will take place.

5.2.1.3 Analytical Perspective

Sections 5.2.2 and 5.2.3 review the environmental effects data from two perspectives:

- **Generic effects for land, water, and actions taken for fish and wildlife are reviewed from the fish and wildlife perspective.** The fish and wildlife perspective is concerned with improvement of fish and wildlife resources, and are discussed in relation to the effects human activities have on fish, wildlife and their habitats. Land and water categories include the overwhelming share of direct effects on fish and wildlife. Most of the adverse effects described below result from human activities or actions that reduce fish and wildlife resources.

- **Generic effects for air, the economic environment, and the social environment are reviewed from the human perspective.** The human perspective is concerned with human improvements, including economic and social values associated with fish and wildlife, and are discussed in relation to the effects that actions taken for fish and wildlife have on people. Most of the adverse effects from the human perspective result from (1) impacts to air quality, (2) losses of fish and wildlife, (3) funding costs of actions taken to rebuild, recover, or protect fish and wildlife populations, or (4) economic and social costs.

Sections 5.2.2 and 5.2.3 address the general nature of environmental effects in six fundamental areas: land, water, fish and wildlife, air, the economic environment, and the social environment. Each subsection provides the following:

- a list of some human activities (whether done for fish and wildlife or human needs) that **cause** an effect,
- a brief description of the possible **adverse effects** that are linked with the particular effect,
- a discussion of the **degree** (context and intensity) of those effects,
- a list of potential **mitigation measures** (actions that will lessen, eliminate, or compensate for the effects), and
- a **discussion** that provides more background information and examples of the intended and associated effects of each activity.

"Effects," "mitigation," "context," and "intensity" are used as they appear in the CEQ Regulations for implementing the procedural provisions of the National Environmental Policy Act. Definitions are found in 40 C.F.R. 1508.8, 1508.20 and 1508.27, respectively.

"Effects" include the following:

(a)Direct effects, which are caused by the action and occur at the same time and place

(b)Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in these regulations are synonymous. Effects include the ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

"Mitigation" includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by reporting, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by presentation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

"Context" includes:

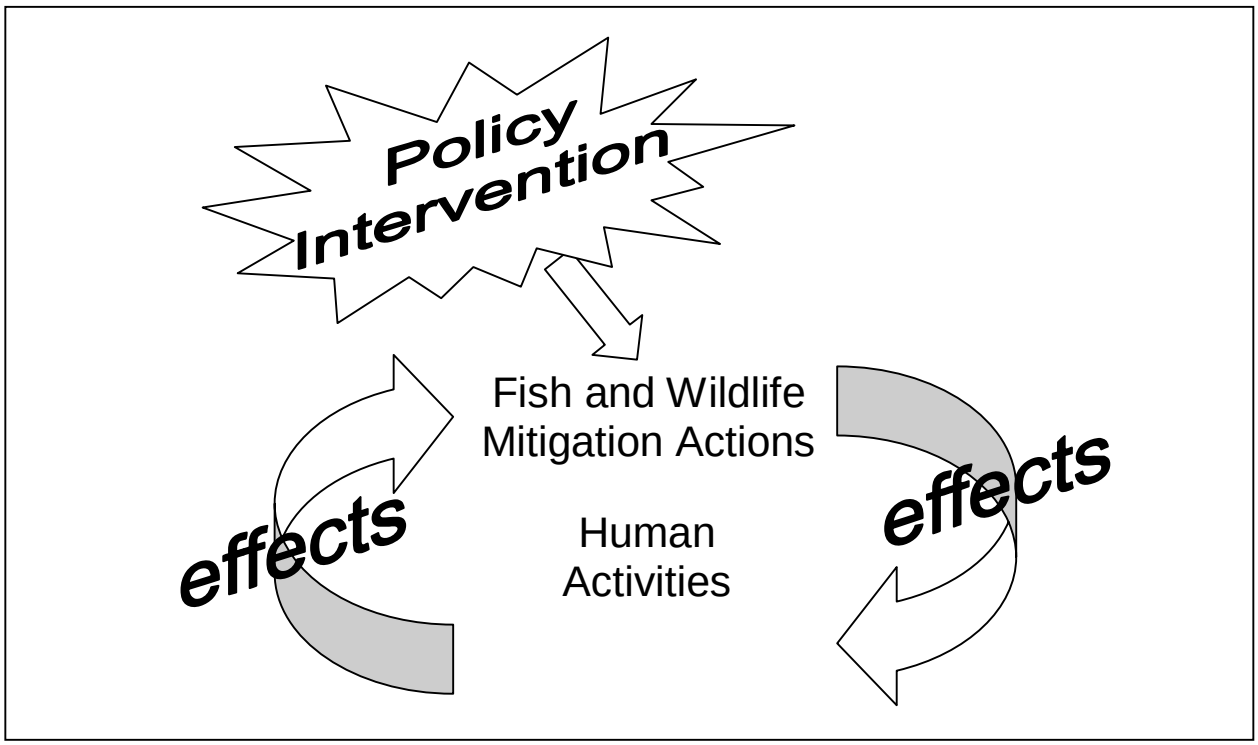
Actions will be implemented in a frame of reference that includes society as a whole, the affected region, the affected interests, and the locality. This means that the significance of a given action may vary with the setting of the action. Both short-term and long-term effects are relevant.

"Intensity" includes:

The intensity of an effect refers to its degree of severity. We consider whether it affects public health or safety, whether it helps or harms a unique resource, whether the effects are likely to be highly controversial, the degree of risk, and the extent to which it supports or adversely affects protected species or resources.

Effects are strongly shaped by how actions are implemented, how human behavior is affected, and by how people respond to the actions. Scientists, elected officials, or other individuals or groups may react by seeking to adjust the policy or the actions in order to improve the intended effects or to mitigate the associated effects, thus beginning a new round of action-effect-reaction. Figure 5-1 illustrates this iterative process.

Figure 5-1: Actions-Effects-Reactions Illustration



5.2.2 Generic Environmental Effects on Fish and Wildlife from Common Human Activities

5.2.2.1 Land[164]

Human Activities

The types of land use activities that affect fish and wildlife and the quality and quantity of their habitat include:

- forestry;
- agriculture, including irrigation, cropping, and grazing;
- mining;
- recreation;

[164] Consequences discussions are drawn directly from existing regional studies. For more information and background, please see: Federal Caucus 1999b and 2000b; Council 2000a; Corps 1999a; USDA/USFS and USDOI/BLM 2000a, 2000b, 2000c, and 2000d; USDOI/USFWS 1998b; USDOE/BPA, Corps, and Bureau 1995, Section 4.3.

- industrial, residential, commercial development;
- road management;
- introduction of exotic species;
- use of land for power generation and transmission facilities.

Possible Adverse Effects

Adverse effects to fish and wildlife and their habitat include:

- direct loss of, or disturbances to, fish and wildlife habitat;
- effects on the quality of fish and wildlife habitat; and
- direct loss, or disturbance of fish and wildlife (including attractive nuisances).

Context and Intensity

Many factors influence the degree of human activity effects on land habitat. The degree of effects is a function of the types, intensity, and amount of land use. These components are themselves a function of economics and social values. Table 5.2-2 lists some of the factors that influence the effects of human activities on fish and wildlife.

Table 5.2-2: Some Factors That Shape Effects of Land Use and Terrestrial Habitat Values on Fish and Wildlife

Factors Leading to Effect	Effect
Market factors such as population growth, demand for land use products, supplies of products from other regions, technology, tastes and preferences, other cultural factors, and environmental regulations	Types and amounts of land uses, intensity of these uses
Public land use policies, pricing of forest products, and grazing	Amounts and intensity of grazing and forestry
Sport fishing and hunting regulations	Recreational fishing and hunting land use
Federal, state, and tribal water doctrines and laws	Amount and characteristics of irrigated land use
Economic conditions, local zoning, and development regulations	Characteristics of development and land use practices

Possible Mitigation Measures

Forestry actions used to reduce potential adverse effects on fish and wildlife habitat include:

- preservation (non-use) of forest lands and stream corridors to allow natural habitat development;
- regenerating vegetation quickly following disturbance;
- modifying harvest practices, tailoring harvest methods to slope and soils, and closing; controlling access; or obliterating forest roads to control use and erosion, and to foster forest regeneration and productivity;

- harvest techniques that retain some of the original forest features such as seral stages, snags, downed wood, large trees, and preferred species;
- creating forest patterns, ages, structures, and compositions to support local wildlife with the preferred habitat qualities;
- developing more sustainable wildlife habitat by silvicultural techniques, including controlled burns; and
- forest stewardship to improve forest health and habitat representation.

Agriculture actions to reduce potential land use conflicts with fish and wildlife habitat include:

- using modified cultivation practices, conservation or no-till agriculture;
- development of small ponds to retain water;
- management of cropland or shifting crop type to improve wildlife values;
- reduce or eliminate harmful pesticides, fungicides, and herbicides;
- land retirement and restoration of land back to native habitat; and
- manage water storage and conveyances reducing impacts to fish and wildlife.

Livestock grazing actions commonly used to reduce livestock effects on fish and wildlife habitat are:[165]

- fencing or herding livestock out of sensitive and riparian areas for as long as necessary to allow vegetation and streambanks to recover;
- separate pastures using different management objectives and strategies for riparian areas;
- strategic placement of watering sources on uplands;
- eliminating livestock management facilities and activities (trailing, bedding, watering, salting, loading) from riparian areas;
- seasonal or rotational grazing, changed grazing intensities, or deferred grazing (adding more rest to the grazing cycle to increase plant vigor, allowing streambanks to heal, or encouraging more desirable plant species composition, and limiting grazing intensity to a level that will maintain desired species composition and vigor);
- controlling the timing of grazing to: (a) keep livestock off streambanks when they are most vulnerable to damage; and (b) coincide with the physiological needs of target plant species;
- changing from cattle to sheep to obtain better animal distribution through herding;

[165] Chaney, E., W. Elmore, and W.S. Platts 1990.

- land acquisition and retirement (permanently excluding livestock from riparian areas at high risk and with poor recovery potential when there is no practical way to protect them while grazing adjacent uplands); and
- constructing wastewater and sedimentation ponds used to retain and treat degraded runoff from feedlots or intensively grazed uplands.

Mining actions to reduce fish and wildlife habitat effects include:

- using best management practices (BMP) for mining;
- avoiding construction of mining structures, support facilities and roads within riparian areas;
- reclaiming and restoring habitat destroyed by mining (including dredging by early miners);
- eliminating solid and sanitary wastes in riparian areas;
- prohibiting or minimizing impacts from surface occupancy for mineral, oil, gas, and geothermal exploration and development activities; and
- minimizing erosion from surface mining and spoils.

Recreation actions include:

- changing sport fishing and hunting regulations;
- educating the public;
- controlling intensity or rotating use;
- locating recreational activities away from fish and wildlife habitat; and
- improving regulations and enforcement.

Industrial, residential, and commercial development actions to reduce effects on fish and wildlife habitat include:

- restricting development in sensitive habitats;
- using acquisitions or conservation easements for sensitive habitats;
- limiting public access or use of habitats;
- changing land use practices to reduce or capture and treat runoff;
- public outreach, including backyard wildlife education;
- developing lands responsibly, designing greenways and leaving native habitat;
- utilizing effective storm water collection infrastructure and management;
- improving laws governing refuse, reuse, and recycling; and
- "fireproofing" the rural/wildland interface.

Road management actions to reduce fish and wildlife habitat effects include:

- retention of roadless areas;

- closing, controlling access to, or reclaiming rural roads;
- road maintenance improvements (mitigation needs may be accomplished quickly by focusing on projects in heavily roaded watersheds[166]);
- providing fish passage;
- providing underpasses for wildlife;
- minimizing roads in riparian areas;
- installing and maintaining fish-friendly culverts;
- regulating traffic during wet periods;
- outsloping of roadway surfaces;
- road drainage improvements;
- sediment source stabilization through seeding and planting;
- avoiding disruption of natural hydrologic flow paths; and
- avoiding sidecasting of soils and snow.

Introduction of exotic species actions to reduce fish and wildlife habitat effects include:

- eliminate or reduce undesirable exotic species, specifically species that have the ability to alter the existing habitat; and
- manage desirable exotic species to minimize effects on native species.

Power generation and transmission actions to reduce fish and wildlife habitat effects include the following:

- spanning riparian, wetlands, and other sensitive areas;
- scheduling construction and maintenance to avoid critical time for sensitive species;
- reseeding/revegetating immediately to protect habitat quality;
- using non-chemical (e.g., mechanical) vegetation management practices;
- installing low-maintenance transmission facilities;
- maximizing use of existing rights-of-way and roads;
- developing and implementing avian protection practices;
- siting generation facilities conscientiously; and
- using air-cooled instead of water-cooled thermal generation.

[166] Lee et al. 1997.

Discussion

Specific land use practices have effects intended to further human interests and associated effects that can impact and limit fish and wildlife and their habitat. The following discussion identifies those intended and associated effects.

Forestry Practices (including timber harvest) can contribute to adversely affecting fish and wildlife through the direct loss or alteration of their habitat. Modifications to cover, food sources, or roosting and breeding areas can affect wildlife health, diversity and abundance. Increased disturbances (e.g. noise and human presence) also impact fish and wildlife habitat use.

Vegetation removal, site disturbance, and soil compaction associated with timber harvest can alter hydrologic and sediment regimes and may increase the hazard of landslides.[167] Canopy removal can alter the amount, frequency, and intensity of precipitation delivery to the forest floor.[168] These changes also may lead to increased amounts of sediment introduced into streams and mobilization of sediments within the stream channel.

Forest management activities can alter processes that create and maintain riparian and aquatic habitats, and result in reductions of habitat complexity and the diversity of aquatic species.[169] Forest practices in riparian areas can be detrimental because of modifications to streamside canopy levels (causing a change in stream temperature and substrate composition) and the removal of large trees that reduce potential contributions of large woody debris to increase stream habitat complexity.[170] Potential adverse effects also include introduction of pollutants (fuels, fertilizers, pesticides, and herbicides) into watercourses while conducting harvest, site preparation, and stand maintenance activities.[171] Hydrologic changes that alter normal stream conditions could result in fish mortality or reduce reproductive success.

Fire management and suppression can have both intended and adverse associated effects on fish and wildlife and their habitat. Fire can be used to improve forest health and create specific seral stages to benefit targeted species. Used properly, it can help reduce the potential for widespread habitat destruction. Burn treatments for forest fuel reduction and other ground-disturbing activities associated with the suppression of wildfires can also remove coarse wood, reduce large wood recruitment, reduce canopy cover, and increase the likelihood of erosion.[172] The use of chemical fire retardants in wildfire

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[167] USDA/USFS and USDOI/BLM 1998; and Murphy, M.H. 1995

[168] Troendle, C.A. and W.K. Olsen 1993.

[169] Elmore, W. and R.L. Beschta 1987; USDA/Forest Ecosystem Management Assessment Team 1993; USDA/USFS and USDOI/BLM 1998.

[170] Chamberlin, T.W., et al. 1991; Murphy, M.H. 1995; Spence, B.C., et al. 1996; USDA/USFS and USDOI/BLM 1998.

[171] Chamberlin, T.W., et al. 1991; Murphy, M.H. 1995; Spence, B.C., et al. 1996; USDA/USFS and USDOI/BLM 1998.

[172] Spence et al. 1996; Rieman, B.E. and J. Clayton 1997.

suppression can have direct and indirect adverse impacts on fish, including direct mortality.[173]

Agriculture can have both intended and associated effects on fish and wildlife and their habitat. Intended effects can come from the different agricultural programs designed to benefit wildlife and their habitat, such as planting wildlife food plots and taking land out of production. The associated effects of cropland, pastureland, and irrigation can sometimes provide habitat benefits (food sources, microhabitats, and open spaces), and improved agricultural management can increase these benefits. For example, the use of hedgerows intended to separate fields and reduce the effects of wind, can result in the creation of microhabitat used by an increased diversity of species. Associated effects of agriculture on wildlife and their habitat can also result in the direct loss of native habitat. Conversion from native habitat to cropland results in a near-complete loss of the original native species that once occupied that land.

Agricultural practices can also affect fish and other aquatic organisms by degrading water quality, reducing water quantities impacting available habitat. Water quality can be affected by increases in stream temperature or increasing sedimentation from riparian, and upland sources[174]; and decreasing instream water quantities due to the irrigation of land (see discussion in Section 5.2.2.2 Water). Increased sediment loads reduce primary production in streams. Draining or filling wetlands for increased production result in the direct loss of aquatic habitat. Persistent degraded conditions adversely influence resident fish populations.[175]

Water storage and conveyance action activities affect land use and fish and wildlife by the dedication of land for facilities, and by shoreline area management. Water conveyance facilities can also be an impediment to wildlife travel.

Livestock grazing can have negative intended effects on wildlife as those species that either compete with or predate on livestock are removed. Associated effects on fish and wildlife result by increasing competition for food and space, degrading habitat, and directly trampling plants or nests. Impacts on stream and riparian areas resulting from grazing are dependent on the intensity, duration, and timing of grazing activities, as well as on the capacity of a given watershed to assimilate imposed activities, and the pre-activity condition of the watershed.[176] Livestock grazing impacts are most severe where riparian areas are non-functional, where range management programs are ineffective at ensuring that terms and conditions of grazing permits are met, and where compliance with permit terms and conditions is low.[177]

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[173] Spence et al. 1996; Rieman, B.E. and J. Clayton 1997.

[174] Armour, C.L., et al. 1991; Platts, W.S. 1991; USDOI/BLM 1992; Chaney et al. 1990.

[175] Meehan, W.R. 1991.

[176] Platts, W.S. 1989; Odum, E.P. 1981.

[177] USDOI/USFWS 1998b.

Livestock allowed in streams or along streambanks, can damage salmonid spawning and rearing habitat. Livestock trampling contributes to reduction of plant life, shading, and loss of important streambank characteristics such as overhangs. Grazing can contribute to a reduction of important riparian habitat. Livestock walk or stand in streams, disrupting fish and other aquatic organisms, and degrading water quality. Fish vulnerability to direct effects of grazing is greatest during early development stages.[178] Heavily grazed watersheds usually exhibit less water holding capacity, potentially resulting in increased runoff velocities, which in turn can result in excessive erosion and sedimentation of streams.

Some wildlife can benefit from the associated effects of grazing. The installation of watering sites and mineral licks, intended for livestock, benefit wildlife as well. Keeping land in pasture also benefits those wildlife species requiring open habitat.

Mining activities can result in positive and negative associated effect on fish and wildlife. Positive associated effects can include the reclamation and creation of habitat, especially aquatic, as mining activities cease. However, there are many negative associated effects. Increased sedimentation (including leachate from abandoned mines), chemical contamination, stream channel modification and destabilization, destruction of riparian vegetation, and hydrologic impacts from associated roads are all major negative associated effects from mining activities.[179] Mining activities also result in the acidification of surface waters.[180] In addition, suction dredge mining can potentially entrain fish embryos, juvenile salmonids, and smaller mature fishes (such as sculpin) into the dredge works.[181]

Mining impacts are most severe when these activities are located near or upstream of fish spawning and rearing areas; and when they occur in watersheds already degraded by past activities and where management emphasis is on resource extraction.[182] Impacts on streams from past mining activity may still affect habitat quality; these impacts can persist for decades.[183]

Recreational use can have both positive and negative intended and associated effects on fish, wildlife, and their habitats. Positive intended effects include habitat protection and enhancement for targeted species, such as waterfowl and songbirds. These effects can result from monies collected from recreational use and equipment fees and licenses. These monies can also be used to support the research and management of selected species. Negative intended effects result from the direct harvest of fish and wildlife, through legal and illegal hunting, trapping, and fishing. Another negative intended effect

[178] USDOI/USFWS 1998b.

[179] Lee et al. 1997.

[180] USDOI/USFWS 1998b.

[181] Harvey et al. 1995.

[182] USDOI/USFWS 1998b.

[183] Lee et al. 1997; MBTSG (Montana Bull Trout Scientific Group) 1998.

is the introduction of a more "desirable" species, which adversely affects native species through competition, predation, and hybridization. The retention of land for recreational activities such as backpacking, horseback riding, recreational vehicle use, and road and trail development have the positive associated effects of preserving fish and wildlife habitat from other more damaging development. However, there is still a negative associated effect with increasing opportunities for recreational uses including recreational facilities such as ski areas and interpretive centers. Recreation development (for example, for parking or other facilities) may result in a loss of habitat, disruption of normal fish and wildlife activities, and deposition of trash (that is, fishing line or food debris that is a hazard to fish and wildlife).

Another negative associated effect on native fish and wildlife comes from the accidental introduction of exotic species. For example, recreational boating has led to the introduction of numerous non-native plants, such as Eurasian watermilfoil, and concern is growing about the potential introduction of zebra mussels.

Another negative associated effect of recreation on fish and wildlife can be caused when anglers wade into streams, destroying anadromous fish nests; by poaching; or through displacing disturbances from recreational noise.[184] Recreational use has the potential to affect aquatic habitat by: (1) altering upland and riparian soil and vegetation conditions that may lead to increased erosion and runoff, loss of cover and food resources, and reductions in water quality; and (2) instream changes that affect stream morphology, water quality, streamflow, substrate, and debris.[185] Recreational impacts are most severe where dispersed or developed facilities are located in nonfunctional riparian areas.

Industrial, residential, and commercial development may result in the negative associated effect of decreasing food sources, modifying habitat, introducing toxic chemicals that can injure or kill fish and wildlife, introducing exotic species, and influencing the hydrology and sediment transport processes, stream temperatures, nutrient cycling, and stream biota.[186] Another negative associated effect on fish and wildlife may result from injury or death from automobiles, boats, and other vehicles. An increasing regional population seeking to live near lakes has affected previously undeveloped rural areas.[187] Positive associated effects can result from increased food availability as increased populations of people generating waste and supplying fish and wildlife with other food sources. However, some might argue that an increase in artificial food sources is a negative associated effect as well.

Road management activities (the construction, use, maintenance, and decommissioning of roads, and the installation, use, replacement, and maintenance of culverts and bridges) can result in negative and positive associated effects on fish and wildlife. Road system

[184] USDA/USFS and USDOI/BLM 1998.

[185] USDA/USFS and USDOI/BLM 1998.

[186] Spence et al. 1996.

[187] USDA/USFS and USDOI/BLM 2000a, Chapter 2 p. 29.

impacts are most severe where riparian areas are non-functional and roaded, where roads and road crossings occur on steep, unstable slopes, and where road densities are greater than 1.36 miles per square mile. The primary negative associated effects from these activities are short-term increases in fine sediment deposition and turbidity downstream of projects.[188] Decommissioned roads may continue to contribute sediment for a few years before sediment levels are effectively decreased.[189] Abandonment of roads includes a risk of increased sediment following rehabilitation activities and sediment inputs from poorly monitored, eroding, abandoned roads. Roads can also alter subsurface and surface water flows that, in turn, may alter both peak and base stream flows.[190]

Other negative associated effects from roads include non-management-related impacts such as noxious weed introductions, illegal transplants of predatory or competing non-native fishes, increased harvest pressure and potential for poaching, dispersed recreation impacts, and potential introduction of toxicants from spills and roadside application of herbicides.[191]

Positive associated effects from road management can include the creation of microhabitats benefiting amphibians, reptiles, and insects (e.g. water in ditches alongside roads or pools of water in the roads). Other wildlife, such as birds and reptiles can benefit from the heat retention of roads in colder weather. Culvert replacement or upgrading should improve fish passage, decrease scouring effects of flood flows, and improve the transport of bedload and debris, though this is largely a mitigation measure. Improved conditions, following the upgrading or replacement of culverts, may occur within days or months. Road decommissioning should improve watershed and habitat conditions, provided that drainage patterns are reestablished.

Introduction of exotic species can have effects on fish and wildlife, and the quality and quantity of their habitat. Most of the effects are negative associated effects and can come from most of the types of land uses previously discussed. For specific discussions on these effects see Recreational Use; Industrial, Residential, and Commercial Development; and Road Management, above and Section 5.2.2.3 Fish and Wildlife.

Power generation (non-hydro) and transmission have negative and positive associated effects on fish, wildlife, and their habitats. These activities affect habitat and fish and wildlife by dedicating land for facilities and by managing the land after construction of facilities.

Negative associated effects from power generation include the loss and degradation of habitat from construction of facilities, and increased human activity resulting in fish and wildlife disturbance and death. Another negative associated effect comes from the

[188] USDOI/USFWS 1998b.

[189] USDOI/USFWS 1998b.

[190] NMFS 1997; Jones, J.A. and G.E. Grant 1996.

[191] USDA/USFS and USDOI/BLM 1998.

reduction of air quality, including the creation of acid rain. Positive associated effects can result in maintaining habitat and reducing further development. For example, the construction of wind farms results in the preservation of larger open spaces.

Negative associated effects from transmission facilities also include habitat loss or degradation due to construction. Other negative associated effects from transmission can include the disturbance, injury, or death of fish and wildlife during construction, operation, and maintenance of transmission facilities. Positive associated effects from transmission include increased nesting, hunting, and roosting habitat for many species of birds. Also, the vegetation maintenance of the transmission corridors provides early successional habitat for songbirds and migration corridors for some mammals. This maintenance also increases species diversity.

Relationship Between Land Use and Water

In general, land management actions that disturb ground and remove vegetation have the following relationships with down slope aquatic resources:[192]

(1) reduce connectivity (i.e., the flow of energy, organisms, and materials) among streams, riparian areas, floodplains, and uplands;

(2) elevate watershed sediment yields, leading to pool filling and elimination of spawning and rearing habitat;

(3) reduce or eliminate instream replenishment of large woody debris that traps sediment, stabilizes streambanks, and helps form pools;

(4) reduce or eliminate vegetative canopy that minimizes temperature fluctuations;

(5) cause streams to become straighter, wider, and shallower, which has the tendency to reduce spawning and rearing habitat and increase temperature fluctuations;

(6) alter peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior;

(7) alter water tables and base flows, resulting in riparian wetland and stream dewatering; and

(8) contribute to degraded water quality by adding toxicants through mining and pest control.

Any of the land use activities described above can affect fish and wildlife, and their habitat quality and quantity as it pertains to water quality and habitat. These relationships and their intended and associated effects are discussed below.

[192] NMFS 1998b; USDA/USFS and USDOI/BLM 2000d.

5.2.2.2 Water[193]

Human Activities

The types of activities that affect water use and value of habitat are as follows:

- diversions and beneficial and consumptive uses of water;
- reservoir operations;
- hydropower operations; and
- land use activities that affect water quality (see Section 5.2.2.1 for a non-exclusive list of land use activities).

Possible Adverse Effects

Adverse effects to fish and wildlife and their habitat include:

- impacts to water quality and flow from land use activities;
- water withdrawals that reduce flow and water quantity and remove organisms from aquatic systems
- impacts to water quality, velocity, and flow through river and reservoir operations for multiple uses;
- loss of riverine habitat caused by reservoir inundation;
- loss of reservoir habitat due to hydro operations; and
- impediments to fish passage caused by dams and other structures and the slack water behind them.

Context and Intensity

Many factors influence the degree of effect human activities have on water use, water quality, and aquatic habitat, as illustrated in Table 5.2-3.

Table 5.2-3: Some Factors That Shape Effects of Water on Fish and Wildlife

Factors Leading to Effect	Effect
Factors affecting land use See Table 5.2-1	Water-induced erosion, degraded runoff, non-point source pollution and sedimentation
Reservoir levels and normal operating range, inflow, spill operations, bypass facilities in place, fish transportation, flows through turbines, turbine efficiency	Fish passage survival; conditions for resident fish spawning, rearing, and foraging
Reservoirs built	Amount of riverine habitat lost
Operations for hydropower, flood control, irrigation, fish and wildlife, other purposes	Downstream flow, water quality, and saturated gas conditions; sedimentation, riparian floodplains

[193] Consequences discussions are drawn directly from existing regional studies. Also see Federal Caucus 1999b and 2000b; Council 2000a; Corps 2002b; USDA/USFS and USDOI/BLM 2000b; and USDOE/BPA, Corps, and Bureau 1995, Section 4.3.

Factors Leading to Effect	Effect
Growth and types of development, water pollution laws, pollution control technology	Amount and characteristics of point-source water pollution, water withdrawals
Agricultural markets, agricultural costs, irrigation technology and costs, water conveyance technology and costs, water conservation and screening incentives	Amount of irrigation, irrigation efficiency, amount of diversion, and mortality of aquatic life

Possible Mitigation Measures

Impacts from **diversions and beneficial and consumptive uses of water** can be improved by the following:

- reducing water withdrawals;
- retiring irrigated land;
- fallowing of irrigated land in dry years to maintain downstream flows;
- using irrigation-water conservation techniques to reduce diversions and return flows, often with water quality and quantity benefits for the aquatic system; and
- screening irrigation diversions to avoid direct mortality of juvenile salmonids.

Reservoir operation impacts to fish and wildlife can be reduced by:

- decreasing nitrogen supersaturation:
  - lower reservoir crest levels;
  - build more reservoir storage capacity; and
  - draft reservoirs deeper for flood control, leading later to reduced spill;
- reducing temperature:
  - adjusting pool elevation to allow cold water releases (but the relationships are complex and differ among projects: storage pools are deep and stratify thermally during the summer, while run-of-the-river pools typically have more uniform temperature distribution);
  - using techniques to provide adequate shade to help control temperature (stable flows and periodic flooding without drawdowns help maintain riparian vegetation for shading);
- minimizing water quality impacts from navigation and recreational boating.

Hydropower operation impacts to fish and wildlife can be reduced by

- improving adult fish passage;
- improving collection and transport past dams (e.g., barging and juvenile bypass systems);
- increasing spill;
- improving turbine efficiency; and

- decreasing nitrogen supersaturation:
  - control spill through increased power generation, the use of storage, surface bypass, and other means;
  - modify facilities to reduce the potential for supersaturated water, such as installing deflectors;
  - use juvenile bypass or transportation systems to keep fish away from areas with supersaturated water;
  - remove dams.

Impacts from **land use activities that affect water quality** can be reduced by the following:

- reduce sedimentation (see Section 5.2.2.1 for examples of possible mitigation for sediment-creating land use activities).
- reduce water temperature by:
  - reducing irrigation return flows (which are often warmer than receiving water) through irrigation water management or land retirement;
  - retaining riparian vegetation shade;
  - reducing water withdrawals;
  - using conservation irrigation techniques; and
  - using air-cooled CTs.
- reduce non-thermal pollution by:
  - fencing out livestock and providing alternative watering sources on uplands to reduce livestock effects on aquatic systems;
  - seasonal or rotational livestock grazing, reduced grazing intensities, deferred grazing, and land acquisition and retirement;
  - strategies to avoid polluted surface water runoff from agriculture, including such changes in farming practices as modified cultivation practices, conservation tillage, no-till agriculture, development of tailwater ponds to retain water, increased use of organic farming techniques, and cropping changes to reduce or capture impaired runoff;
  - using BMPs to prevent offsite water quality degradation from feedlots;
  - using strategies to reduce degraded irrigation return flows, including irrigation land retirement, lease or purchase of irrigation water, and irrigation water conservation;
  - using wastewater and sedimentation ponds to retain and treat degraded runoff from uplands;

- capping contaminated sediments with clean material (contaminated sediments are rarely dredged because dredging disperses the pollutants and creates a disposal problem); and
- filtering or distilling out metals and organic contaminants in water (the processes are expensive and typically sterilize the water of all living organisms).

Discussion

Diversions and Beneficial and Consumptive Uses of Water can result in associated effects on fish and wildlife from changes in water quantity and quality. Negative associated effects can stem from draining wetlands or dewatering streams for irrigation, which can result in the mortality of fish and other aquatic species. Diverting water from natural stream habitat into constructed channels for agriculture also has negative effects on fish, wildlife, and their habitats. These diversions reduce habitat connectivity for fish and other aquatic species. These same constructed channels can impede wildlife movements and diminish natural sources of water. The withdrawal of water for other beneficial and consumptive uses can cause negative associated effects related to water quality. Water returning to the rivers and streams after being put to a beneficial use (e.g., irrigation return flows and discharge from industrial or other sources) can alter stream temperatures or increase pollution.

Hydropower Operations and **Reservoir Operations** can have both intended and associated effects on fish, wildlife, and their habitats. Hydropower and reservoir operations have positive intended effects for fish and wildlife. For example, hydropower operation is tailored to insure adequate flows in the Vernita Bar area helping to maintain strong healthy populations of fall chinook salmon (upriver brights). It should be acknowledged, however, that many intended effects are from mitigation actions. Structural improvements, such as adult and juvenile anadromous fish passage (e.g., fish ladders, juvenile bypass systems, and fish friendly turbines), and operational changes, including modifications of flow and spill regimes, are intended to improve conditions and survival for anadromous fish. These mitigation actions also have associated effects that are both negative and positive. A negative associated effect from the structural improvements includes increased anadromous fish predation and mortality related to sudden pressure changes and disorientation. Positive associated effects from these structural improvements included increased prey base for fish and avian predators and dam passage for resident fish. Operational changes also result in positive associated effects. These include increased dissolved oxygen levels, prey availability, resident fish passage, and habitat availability downstream. Negative associated effects include increased total dissolved gas supersaturation, water temperature, and anadromous fish predation. As spill increases, the incremental benefits of increasing spill diminish. At higher spill levels, the risk of undesired effects also increases, including risks to both juvenile and adult migrants (as well as resident species) from gas supersaturation and adverse hydraulic conditions.

Dam and reservoir operation also have negative intended effects on fish, wildlife, and their habitat. Historically, choices were made to give a priority to power, irrigation, flood control, navigation, and recreation over the needs of anadromous fish. Today operational choices are made that are intended to negatively affect strong fish stocks in order to benefit listed fish. Another intended effect on fish is reservoir operations designed to allow for continued recreational fishing opportunities.

Associated effects of dam and reservoir operations can be both positive and negative. Positive effects arise from reservoir operations that result in maintained levels benefiting resident fish and wildlife. For example, the creation and operation of reservoirs has resulted in increased resident fish populations like the northern pikeminnow and smallmouth bass. The documented adverse effects of hydroelectric project development on fish and aquatic life are numerous and generally irreversible, and occur to some degree regardless of the mitigation measures applied to reduce the level of effects.[194] During their downstream migration, juvenile anadromous fish can be harmed by the hydrosystem in several ways.[195] Adverse associated effects include loss of fish passage, loss of spawning habitat, disruption of hydrologic connectivity (both laterally and longitudinally), changes in stream water temperature, increased salmon predation, altered patterns of nutrient cycling, and reduction in water quality and natural channel functioning. The creation of reservoirs has also resulted in increased migration times further affecting anadromous fish survival.

As previously stated, dam and reservoir operations have negative associated effects on fish, wildlife, and their habitat through the reduction of water quality. One effect on water quality comes from increased nitrogen supersaturation, also known as total dissolved gas, which is associated with spill. As spill increases so does the amount of dissolved gas resulting in negative effects on fish.

Flow augmentation can result in increased turbidity, the amount of non-thermal pollution, and alter the temperature regime. Negative associated effects from flow are often tied to reservoir management. Increased water turbidity caused by disturbance of existing sediments behind the dam and reservoir bank erosion from reservoir operations can have adverse effects on fish and wildlife. However, some level of sediment may be important to certain organisms. For example, turbid conditions during spring freshets may be helpful to migrating juvenile salmon and sturgeon. Sedimentation reduces survival of eggs and alevins, reduces primary and secondary productivity, interferes with feeding, causes behavioral avoidance and breakdown of social organization, and fills pools or adds new, large structures to channels.[196] Sediment can also contain non-thermal pollutants harmful to fish, wildlife, and their habitat. They represent a hazard to aquatic

[194] USDOI/USFWS 1998b.

[195] NRC (National Research Council) 1996.

[196] Spence et al. 1996.

life and human health because of their toxicity at low levels, persistence, and bioaccumulation factors.[197]

Water temperatures can increase or decrease downstream as a result of water released from reservoirs. Cold water releases are meant to lower water temperature for salmonids, although it can also cause increases in sedimentation. Other water releases can cause temperature increases as warm water is released from the reservoir. These temperature increases can result in higher fish mortality.

Land Use Activities that Affect Water Quality have positive and negative intended and associated effects. For a complete discussion see Section 5.2.2.1 above.

5.2.2.3 Fish and Wildlife[198]

Human Activities

The previous two sections explained how human use of land and water affects fish and wildlife. Fish and wildlife life-cycle diagrams (Figures 5-2, 5-3, 5-4, 5-5, 5-6, and 5-7) were created to illustrate where in the life cycles different effects occur and have the most impact. The interaction of land and water effects with the life cycles is central to the analysis conducted in Section 5.3 below.

Land and water use activities are not the only human activities that affect fish and wildlife. Other human activities that affect fish and wildlife include the following:

- commercial harvest, including tribal and non-tribal;
- recreational hunting and fishing;
- fish hatcheries and other artificial production facilities;
- introduction and spread of exotic plants and animals; and
- fish and wildlife management activities.

Possible Adverse Effects

Some examples of major adverse effects at particular life-cycle stages of fish and wildlife are shown in the diagrams on the following pages. Many of these effects were discussed in Sections 5.2.2.1 and 5.2.2.2, including hunting, recreational fishing, and quality and quantity of habitat. Other adverse effects include:

- direct harvest mortality, including commercial fish harvest and recreational hunting and fishing;
- incidental (bycatch) harvest mortality;

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[197] NRCC (National Resource Council of Canada) 1981; Eisler, R. 1986.

[198] Consequences discussions are drawn directly from existing regional studies. Also see Federal Caucus 1999b and 2000b; Council 2000a; Corps 1999a; USDA/USFS and USDOI/BLM 2000a and 2000b; and USDOE/BPA, Corps, and Bureau 1995, Section 4.3.

- poaching;
- reduced genetic diversity by harvest;
- competition with hatchery fish for food and space;
- artificial selection and breeding with hatchery-produced fish, leading to long-term changes in genetic characteristics of stocks;
- competition for space or food, predation, or replacement of valuable food sources by exotics;
- maintenance of unnaturally high predator populations by large influxes of juvenile hatchery and exotic fish;
- interference with movement and migration;
- mortality due to delayed migration;
- disease; and
- habitat loss.

Context and Intensity

Many factors can influence the effects of human activities on fish and wildlife. Many of these factors are related to land and water effects; these factors were noted above in Tables 5.2-2 and 5.2-3, respectively. Additional factors include harvest (hunting and fishing), hatcheries, and introduced species as shown in Table 5.2-4. In addition, many social, cultural, and economic factors interact with habitat, harvest, hatcheries, and hydro to determine their consequences for fish and wildlife, as discussed in Section 5.2.3.

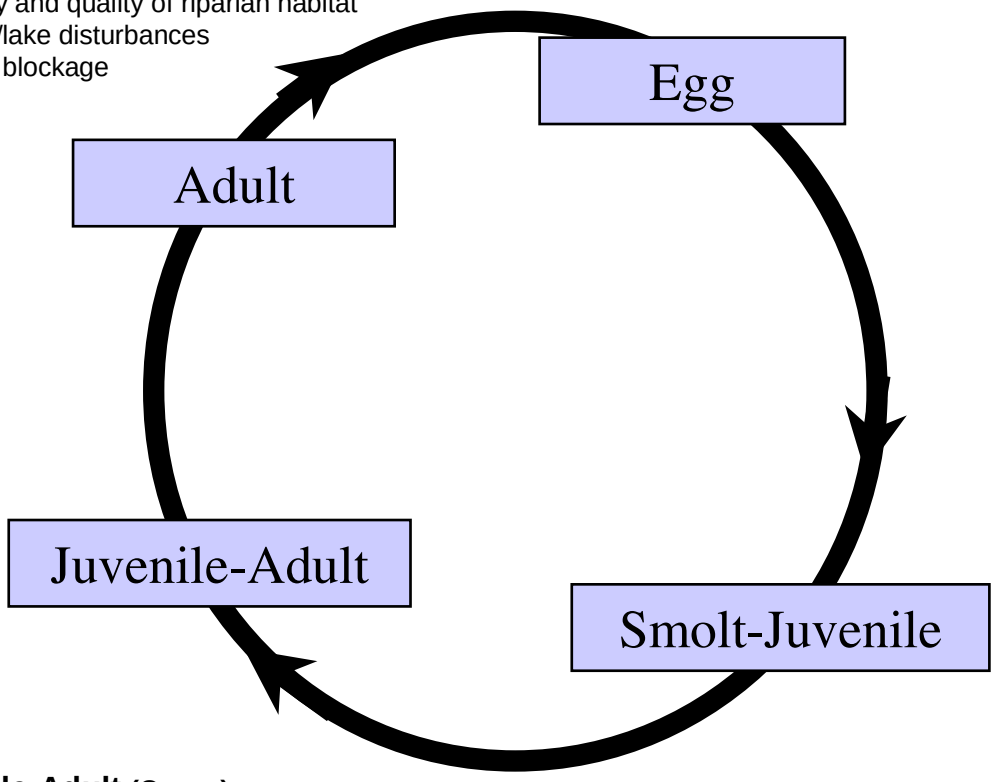
Table 5.2-4: Some Factors That Shape Effects on Fish and Wildlife

Factors Leading to Effect	Effect
Land use and terrestrial habitat	Amount and quality of terrestrial habitat; see Table 5.2-1
Water use and aquatic habitat	Amount and quality of aquatic habitat; see Table 5.2-2
Commercial fishing seasons, regulations, economics, size of the fishing fleet	Direct and incidental fish mortality
Recreational fishing seasons, regulations, gear restrictions	Direct and incidental fish mortality
Recreational hunting seasons, regulations	Direct and incidental wildlife mortality
Poaching (illegal hunting and fishing) and illegal trade	Direct and incidental fish and wildlife mortality
Number of fish produced by hatcheries, timing and location of releases; types of hatcheries	Interaction of hatchery and wild fish, extent of cross-breeding and introduction of disease
Types, locations, and densities of exotic plant and animal species	Interactions between exotic and native species; localized native species extinctions

**Figure 5-2: Examples of Major Adverse Effects:
Anadromous Fish Life Cycle**

Adult
(Pre-spawning/Migrating upstream)
- Competition with other species
- Dam passage
- Disease
- Fishing
- Overall watershed hydrologic imbalance
- Predation
- Quantity and quality of instream habitat
- Quantity and quality of riparian habitat
- Stream/lake disturbances
- Stream blockage

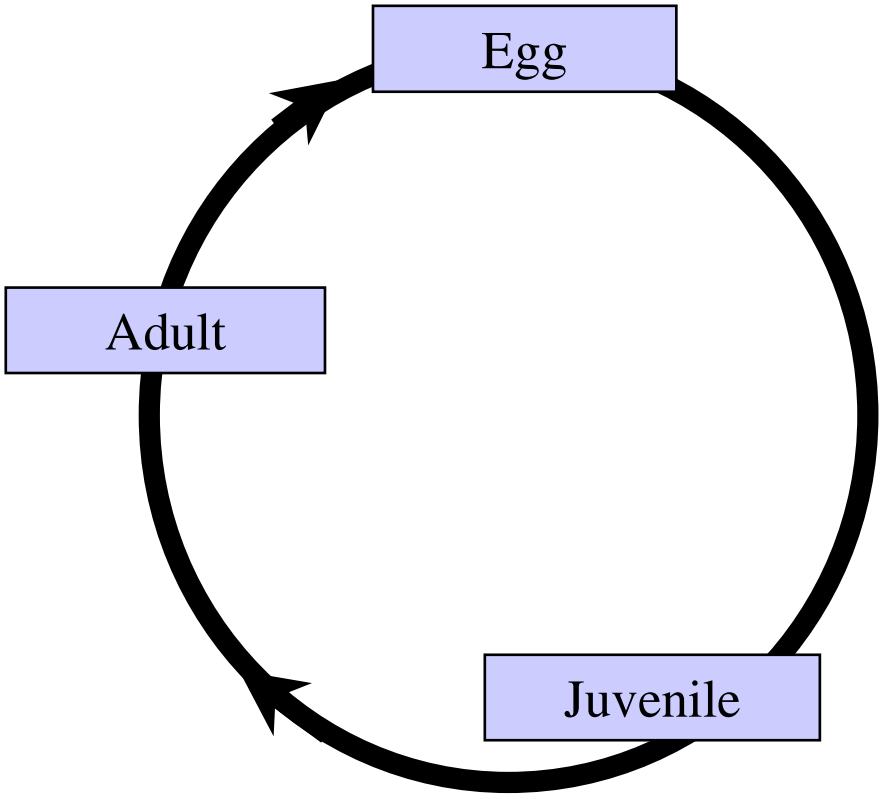
Egg – Alevin – Fry - Fingerling
- Competition with other species
- Disease
- Lack of food
- Overall watershed hydrologic imbalance
- Predation
- Quantity and quality of instream habitat
- Quantity and quality of riparian habitat
- Stream/lake disturbances



Juvenile-Adult (Ocean)
- Chemical pollutants
- Competition with other aquatic species
- Disease
- Fishing
- Lack of food, nutrients
- Lack of oxygenation
- Predation
- Water temperature too warm, too cold

Smolt – Juvenile
(Migrating downstream)
- Competition with other species
- Dam passage
- Disease
- Incidental take by fishers
- Lack of food
- Overall watershed hydrologic imbalance
- Predation
- Quantity and quality of instream habitat
- Quantity and quality of riparian habitat
- Stream/lake disturbances
- Stream blockage

**Figure 5-3: Examples of Major Adverse Effects:
Resident Fish Life Cycle**



Egg – Juvenile
- Competition with other species for food and space
- Disease
- Lack of food
- Overall watershed hydrologic balance
- Predation
- Quantity and quality of instream habitat
- Quantity and quality of riparian habitat
- Stream/lake disturbances

Juvenile – Adult – Spawning Adult
- Competition with other species for food, space, spawning habitat
- Dam passage
- Disease
- Fishing, including incidental take
- Lack of food
- Overall watershed hydrologic balance
- Predation
- Quantity and quality of instream habitat
- Quantity and quality of riparian habitat
- Stream/lake disturbances
- Stream blockage

**Figure 5-4: Examples of Major Adverse Effects:
Life Cycle of Sharp-tailed Grouse**

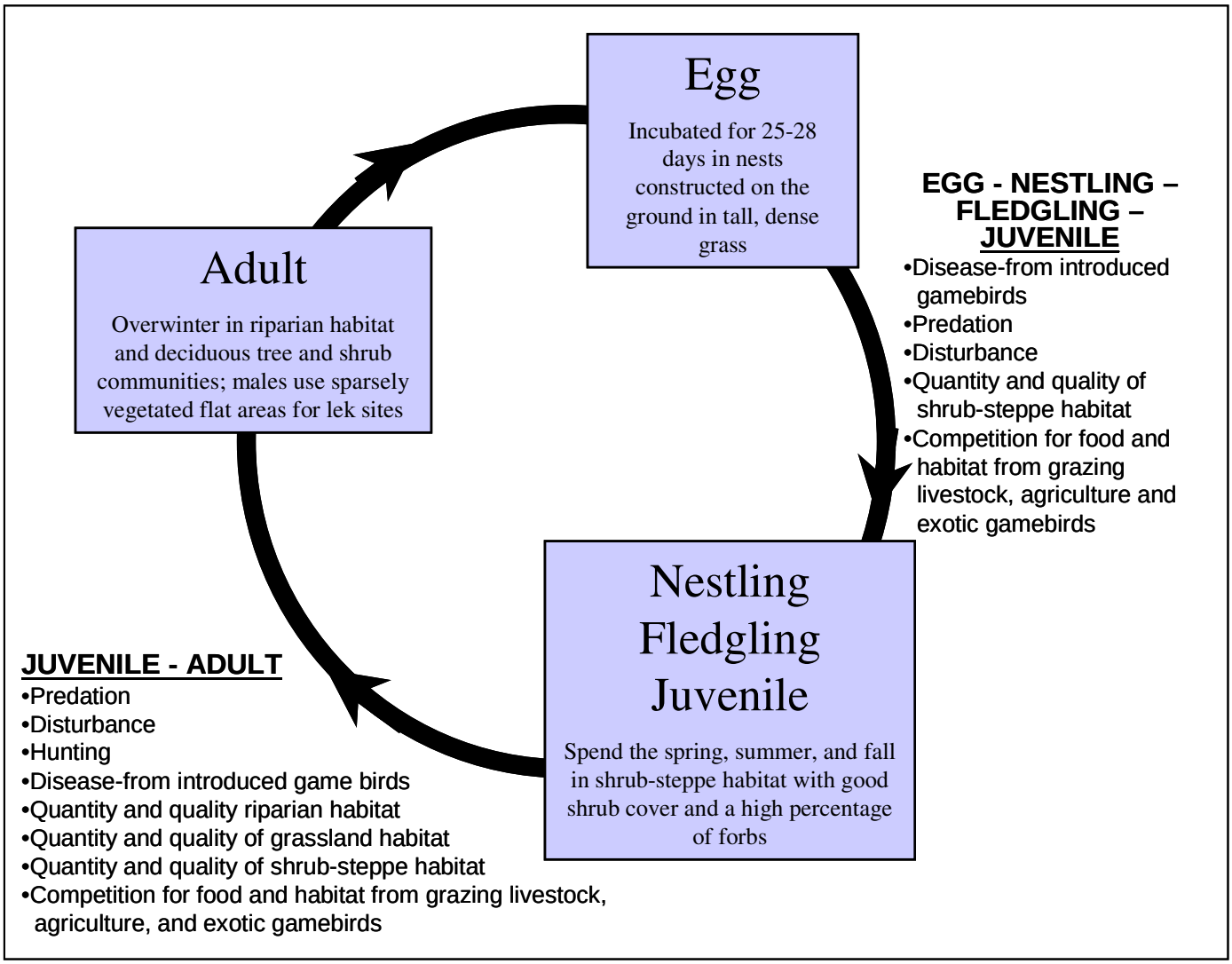


**Figure 5-5: Examples of Major Adverse Effects:
Life Cycle of the Bald Eagle**

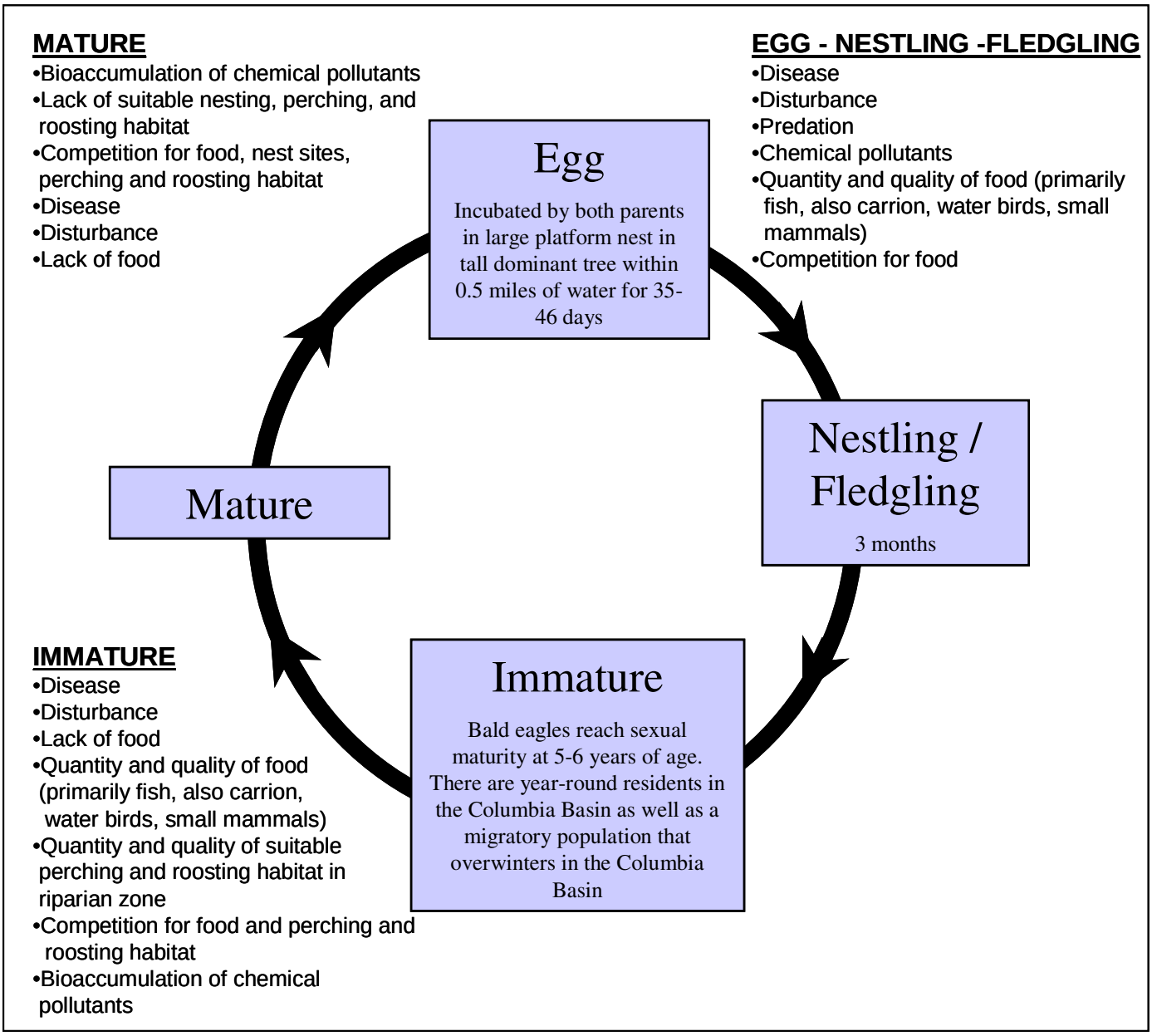


**Figure 5-6: Examples of Major Adverse Effects:
Life Cycle of Migratory Nesting Waterfowl**

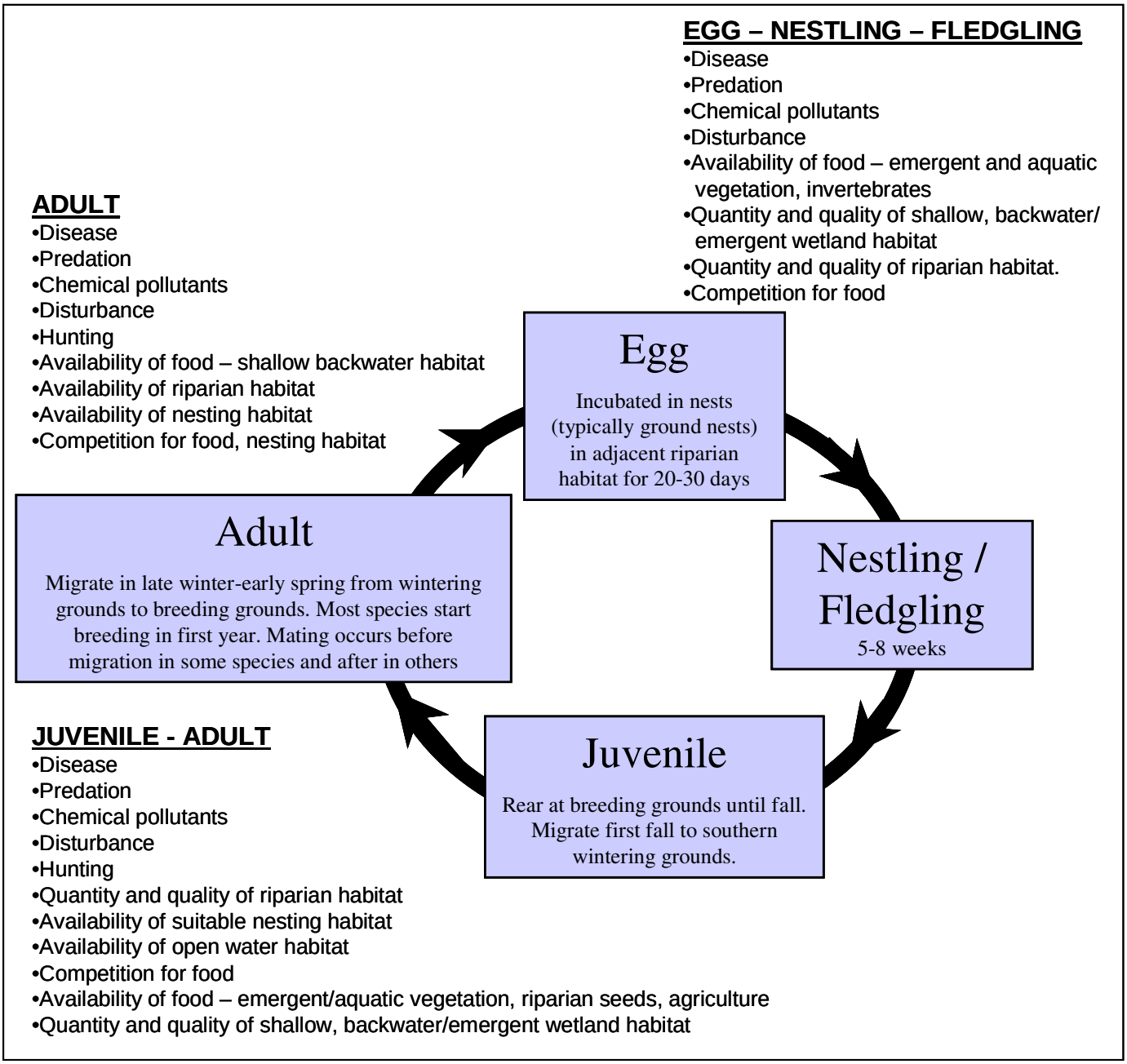
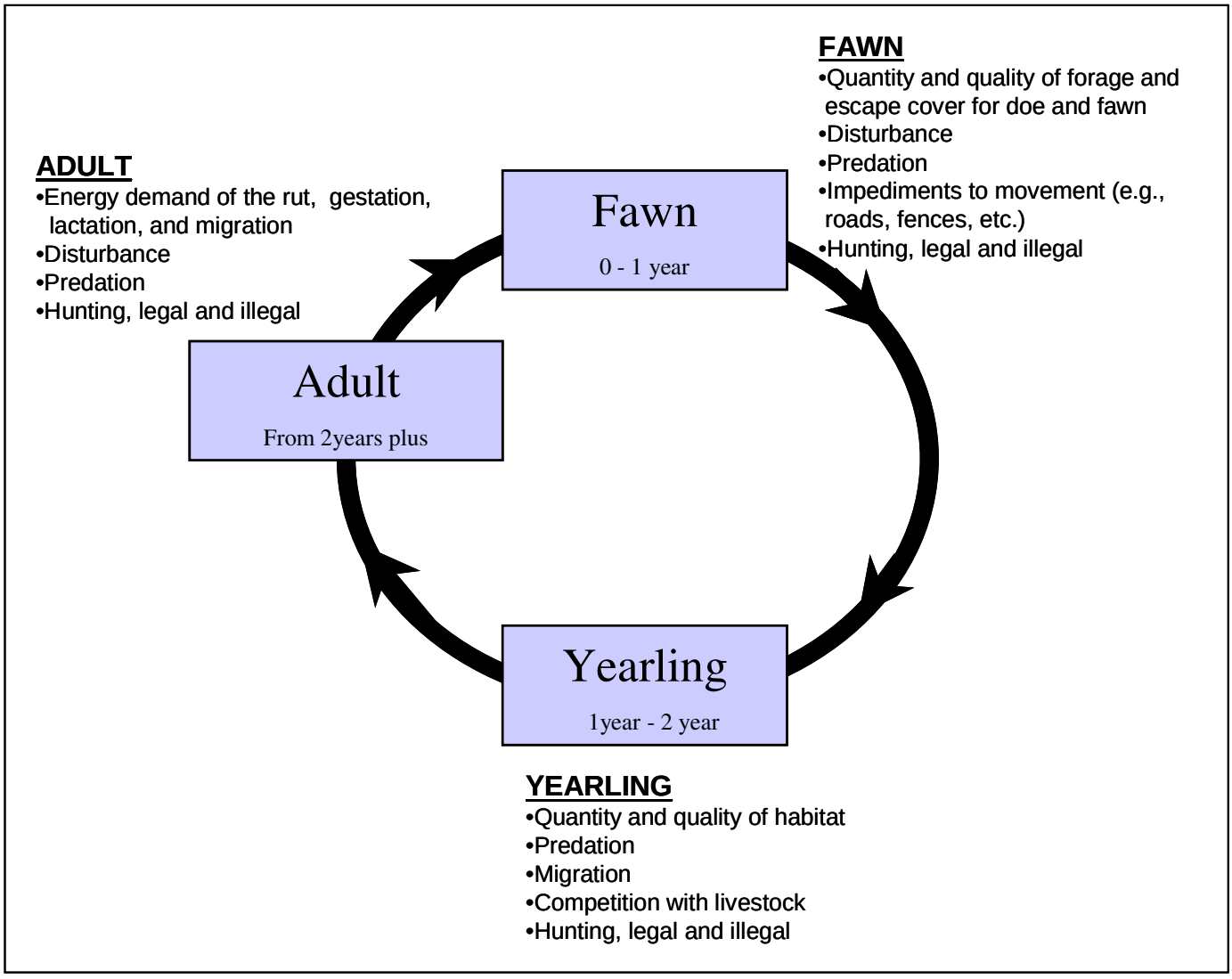


**Figure 5-7: Examples of Major Adverse Effects:
Life Cycle of Deer**



Possible Mitigation Measures

Commercial harvest impacts to fish and wildlife can be reduced by:

- reduction of the fishing season;
- reduction of catch limits;
- change of fishing gear regulations;
- increased enforcement of regulations;
- development of selective fishery techniques;
- change of international fishing treaties;
- buy-out of fishing permits;
- development of terminal fisheries;

Recreational hunting and fishing impacts to fish and wildlife can be reduced by:

- reduction of hunting and fishing seasons;
- reduction of bag/catch limits;
- changes of gear regulations (such as flies only or barbless hooks);
- increased enforcement of regulations;
- controlled hunts and selective harvests.

Hatchery impacts to fish can be reduced by:

- phase-out hatcheries;
- shift to conservation hatcheries;
- employ management techniques such as supplementation to provide eggs and juveniles for outplanting;
- mark hatchery fish for better identification when harvested;
- eliminate hatchery production of non-native fish; and
- use stream-specific brood stock and regulate the timing and location of releases.

Impacts from **exotic species** on fish and wildlife can be reduced by:

- increase regulations and penalties for importing exotic species;
- actively manage the spread of introduced species;
- eliminate hatchery production of non-native species; and
- focus on enhancing habitat with native vegetation.

Impacts from **fish and wildlife management** on other non-targeted fish and wildlife can be reduced by:

- reducing spill intended for anadromous fish to benefit resident fish;
- eliminate stocking of non-native species (e.g., brown trout, chukar); and
- shift to an ecosystem management approach.

Discussion

Commercial harvest may fluctuate in response to such variables as ocean productivity cycles, periods of drought, and natural disturbance events. Harvest has both intended and associated effects on fish and wildlife. A negative intended effect of commercial fish harvest is the reduction in fish populations through actual harvest. Negative associated effects from harvest include incidental catch of non-target fish species (bycatch), reduction in genetic diversity, and the mortality of marine mammals. A positive associated effect of fish harvest can include a reduction in species competition through lower populations.

Recreational hunting and fishing can have both intended and associated effects on fish and wildlife. Similar in nature to commercial harvest, a negative intended effect is the reduction of fish and wildlife populations through increased mortality. A positive intended effect, correlated to fish and wildlife management activities, includes a increase in fish and wildlife as hunting and fishing is used as a management tool to improve species health (see Fish and Wildlife Management Activities, below). Negative associated effects on fish and wildlife include injury, incidental mortality, and behavioral disturbances. Positive associated effects include the reductions of density related pressures, like disease, and increased genetic diversity.

Hatcheries have both intended and associated effects on fish and wildlife. Negative intended effects on fish result from the main purpose of hatcheries: to produce fish for harvest. A positive intended effect is increased stock viability, an intended purpose of the conservation hatcheries. There are numerous negative associated effects on fish and wildlife. The negative associated effects on fish include the contribution to extinctions of wild runs, inbreeding and the promotion of deleterious genes, increased competition for food and habitat, increased predation on wild fish, disease spread to wild fish, reduction in war quality from increased effluent, and shifts in migration timing. Negative associated effects on wildlife include reductions in water quality from increased effluent, and predator controls at hatchery facilities.

Exotic Species can have both intended and associated effects, both positive and negative, on native fish and wildlife. A negative intended effect from exotic species is the elimination of undesirable native species. Positive intended effects from exotic plant species include the increase in forage for native herbivores and cover for other species. Some negative associated effects from introduced species on native fish and wildlife are the elimination of or competition with native species, spread of disease, hybridization, reduced genetic diversity, maintenance of an artificially high predator base[199], impacts to the quality and quantity of habitat.

Fish and Wildlife Management Activities are taken to meet the needs of humans, whether it is for consumptive (e.g., commercial harvest, recreational hunting and fishing)

[199] Predator levels are kept artificially high when introduced prey species increase. This is turn can result in increased predation of the native prey species.

or non-consumptive (e.g., bird watching, existence value) uses. Wildlife management activities include habitat improvements such as winter range burning, reconnecting habitat, and reducing fragmentation; water developments; and snag management. Fish management activities include streambank restoration, fish reintroductions, conservation hatcheries, and retention of instream woody debris. These activities can have both intended and associated effects on fish and wildlife. Negative intended effects include the intentional removal of targeted, unwanted species (e.g., northern pikeminnow bounties, culling ungulate herds, dewatering stream). Positive intended effects can include increases in species and genetic diversity, abundance of targeted species, and quality and quantity of habitat. Positive intended effects can also be increases in habitat diversity and connectivity. Some negative associated effects on fish and wildlife are the death of non-targeted species, reductions in the quantity and quality of habitat, and increased competition, predation, and stress between targeted and non-targeted species. For example, instream habitat restoration projects may cause short-term sedimentation.[200] Surveys and population sampling, such as smolt traps and electrofishing, will result in harassment and may result in injury or death of individual fish. Many of the intended and associated effects on fish and wildlife from fish and wildlife management activities are the same as those previously discussed in the effect categories above.

5.2.3 Generic Environmental Effects on Humans from Actions Taken for Fish and Wildlife Mitigation and Recovery

***MAJOR SUBJECTS**: This section focuses on the potential effects from fish and wildlife mitigation and recovery efforts on humans, including the following areas:*

- *Air Quality*
- *Economic Environment*
- *Social Environment.*

5.2.3.1 Air Quality[201]

Fish and Wildlife Actions

The types of fish and wildlife actions that can affect air quality include:

- reservoir drawdown or breaching; and
- changes in hydrosystem operation resulting in air emissions from replacement power; and
- wildlife range burning.

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[200] Consequences discussions are drawn directly from existing regional studies. Also see Federal Caucus 1999b and 2000b; Council 2000a; Corps 1999a; USDA/USFS and USDOI/BLM 2000b and 2000c; and USDOE/BPA, Corps, and Bureau 1995, Section 4.3.

[201] Consequences discussions are drawn directly from existing regional studies. Also see Federal Caucus 1999b and 2000b; Council 2000a; Corps 1999a; USDA/USFS and USDOI/BLM 2000; and USDOE/BPA, Corps, and Bureau 1995, Section 4.3.

Possible Adverse Effects[202]

Possible adverse effects are listed below.

- **Reservoir drawdown and breaching** can result in the following effects:
  - dust blowing from exposed reservoir sediment (some of which may contain heavy metals and other potentially toxic materials);
  - increased emissions and dust from deconstruction activities;
  - increased emissions from rail and truck traffic as a result of the loss of navigation;
  - increased air emissions from thermal generation to replace lost hydropower (however, these increased emissions could be limited by relying on energy conservation and renewable energy resources, such as wind.); and
  - reduction in visibility from increased photochemical smog and particulate matter.
- **Changes in hydrosystem operations** can result in increases in the following emissions as a result of increased thermal generation:
  - particulate matter can have adverse health effects; it can also discolor paint, corrode metal, and reduce visibility;
  - heavy metals can permanently damage the brain, kidneys, and developing fetuses. Some heavy metals bioaccumulate and render fish and wildlife unhealthy to eat;
  - CO in low concentrations results in flu-like symptoms, and is lethal in high concentrations;
  - SO_2 causes corrosion, respiratory irritation, and reduced visibility;
  - NO_x have effects similar to SO_2, and can also slow plant growth and reduce crop yield;
  - CO_2, characterized as a greenhouse gas, absorbs heat radiated from the earth, contributing to global warming; and
  - some PAHs are probable human carcinogens and may cause other detrimental human health effects.
- **Wildlife range burning** can result in the following effects:
  - increased particulate matter from wind erosion after fire treatments can have adverse health effects; it can also discolor paint, corrode metal, and reduce visibility; and
  - increased CO_2 due to burning organic material contributing to global warming.

[202] USDOE/BPA, Corps, and Bureau 1995, Section 4.2.3.

Context and Intensity

Most factors influence the amount, location, and severity of air quality effects; some of these factors are listed in Table 5.2-5. The types, amount, and location of new generation capacity are also important; these factors are shown in Section 5.2.3.2, Table 5.2-6.

Table 5.2-5: Some Factors That Shape Effects on Air Quality

Factors Leading to Effect	Effect
Replacement power for lost or reduced hydropower generation	Emission characteristics of new generation
Which dams are breached	Location of most upstream navigation port and amount of new transportation and air emissions required, amount and location of exposure of reservoir bottoms and particulate air effects, amount and location of air quality problems caused by deconstruction
Shift to rail and truck transportation to replace lost navigation	Selection and location of new mode of transportation, and type and location of air pollution
Type and timing of restoration of former reservoir bottoms, weather conditions during exposure, success of restoration	Particulate matter exposure levels and duration
Wildlife range burning	Degraded air quality in terms of particulate matter and CO_2

Possible Mitigation Measures [203]

Appropriate mitigation measures for adverse air quality effects vary according to the source of the air emission.

Mitigation **for particulate matter from exposed sediments,** may include:

- reseeding as soon as practical;
- remove and treat heavy metal sediment;
- land contouring and management to reduce wind erosion; or
- watering to reduce wind erosion.

Mitigation **for products of thermal generation (most likely combustion turbines)**, may include:

- power facility location;
- substitute renewable power sources for thermal generation;
- use of modern air pollution control technology; and
- carbon sequestration.

[203] USDOE/BPA, Corps, and Bureau 1995, Section 4.2.3.

Mitigation **for increased air pollution from transportation**, may include:

- increased vehicles emission controls;
- use of rail instead of trucks where possible;
- highway improvements to accommodate increased traffic; and
- carbon sequestration.

Mitigation **for increased air pollution from prescribed range burning**, may include:

- timing and weather restrictions;
- size and pattern of area burned;
- frequency of burns; and
- location of range to be burned.

Discussion

Reservoir drawdown and breaching to benefit fish and wildlife can have negative associated effects on humans in terms of reduced air quality. These effects are a result of increased particulate matter caused by erosion and exposed sediment from drawdown and breaching; increased dust and emissions from deconstruction activities; and increased emissions as transportation shifts from navigation to road and rail. The associated effects include impacts to human and animal (livestock) health through degraded air quality; and crop and forest damage, damage to buildings and other structures, and reductions in water quality through increased acid rain and chemical depositions. Two other associated negative effects include reductions in visibility and increased contributions to global warming.

A short-term positive associated effect is improved air quality as industrial production is curtailed due to rising energy costs from the loss of hydro generation. However, in the long-term this positive effect would likely be quickly followed by a negative effect as other power producers develop new thermal generation, which could include diesel. This would result in some of the industrial facilities resuming full production, resulting in increased emissions. Also, as a result of increased power costs, some residential customers may switch to lower cost fuels relying more on wood or fossil fuels, further impairing air quality.

Changes in hydrosystem operations to benefit fish and wildlife can have similar associated effects as those discussed in **Reservoir drawdown and breaching** above, but to a lesser extent. A positive associated effect from changes in hydrosystem operations is related to the installation of high-efficiency, fish-friendly turbines. The increased hydroelectric power generated would delay the need for air-quality impairing thermal generation.

Wildlife range burning has negative associated effects. The exposure of soils and the creation of ash increases particulate matter through wind—degrading air quality for humans. Also, burning organic material creates CO_2, which contributes to global

warming. Both of these can also result in decreased visibility. However, regeneration of wildlife range vegetation can result in decreases of CO_2, through carbon sequestration.

5.2.3.2 Economic Environment

Actions taken for fish and wildlife affect economic activities. Those most affected by fish and wildlife actions are as follows:

- Power and Transmission;
- Transportation;
- Agriculture, Ranching, and Forest Products;
- Commercial Fishing;
- Other Industry;
- Recreation; and
- Industrial, Residential, and Commercial Development.

Some actions specifically impact a particular industry. Actions to reduce fish harvest, for example, have readily identifiable effects on commercial fishing. Actions such as fencing sensitive areas for wildlife would most likely impact ranching. Other actions taken for fish and wildlife can affect several industries.

Habitat actions to improve riparian lands may affect multiple industries, such as agriculture, ranching, and forestry; or development, depending on which industry happens to be located in the riparian zone. Dam breaching for anadromous fish would likely affect all the economic areas listed above.

Some actions may not affect any particular economic area. For example, actions to modify instream areas and instream passage might not create any loss of economic activity in any industry; economic costs are generally just the costs of implementing the actions. Instead the regional economy as a whole is impacted by the cost of funding and implementing fish and wildlife mitigation and recovery actions.

Following the assessment for each economic area below is a discussion of the potential generic effects of actions taken for fish and wildlife on the regional economy including regional employment.

Power and Transmission

Fish and Wildlife Actions

The types of proposed fish and wildlife actions that would affect electric power generation and transmission include:

- dam breaching or reservoir drawdown;
- changes in hydrosystem operations;
- dam and facility modifications;

- changes in transmission rights-of-way maintenance; and
- routing and technology changes of new transmission.

Possible Adverse Effects

The possible adverse effects to power and transmission from mitigation and recovery actions include:

- dam breaching or reservoir drawdown that results in a loss of electrical generation at a specific location;
- breaching or drawdown may affect downstream hydrology reducing power generation;
- changes in reservoir operations affect timing and amount of power generation;
- dam and facility modifications can result in decreased power generation and inefficient use of transmission;
- decreased transmission reliability affected by large shifts in the location, timing or amount of generation capacity;
- changes in system operations could result in the need for new transmission facilities;
- altered or decreased transmission maintenance activities (vegetation removal, pesticide use) in sensitive habitat, causing costs to increase;
- decreased road densities that affect transmission facility access and reliability; and
- decreased power system reliability resulting in outages.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on power generation and transmission as Table 5.2-6 illustrates. The degree of effect is a function of the amount of hydropower generation lost and transmission reliability compromised.

Table 5.2-6: Some Factors That Shape Effects on Power Generation and Transmission

Factors Leading to Effect	Effect
Dam breaching or reservoir drawdown	Amount of power loss, cost unpredictability for replacement power, new transmission required for changes in power generation
Specific changes in hydro operations	Amount of power loss or gain, cost unpredictability
Dam and facility modifications	Amount of power loss or gain, cost unpredictability
Timing of power loss or gain	Cost
Extent to which fish and wildlife policies may influence hydro generation	Amount and type of new generation required to meet load, and the transmission required to support new generation

Factors Leading to Effect	Effect
Changes that alter the present availability of transmission facilities, the capacity of the lines, and the ability to reroute power efficiently in emergency conditions	Cost of new transmission facilities to maintain system reliability
Fish and wildlife limitations that alter maintenance practices across the system	Costs increase, and transmission reliability may decrease (e.g., outages)

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for the adverse effects include:

- Increase cost-effective energy conservation to reduce electricity use. Electricity consumers could be encouraged to consume less by education, subsidies, higher prices, or by development and application of new technology.
- Increase thermal generation to replace lost hydropower. Natural-gas combustion turbines are currently the most likely replacement for peaking and base load capability.
- Use renewable energy resources to replace lost hydropower.
- Increase power imports or decrease power exports to reduce power replacement.
- Reduce spill, providing opportunities to increase power generation.
- Locate new generation facilities where there is available transmission capacity.
- Maximize use of existing rights-of-way to increase transmission capacity and reliability.
- Install low maintenance transmission facilities.
- Use non-chemical options for vegetation management in transmission rights-of-way.

Discussion

Fish and wildlife actions can have both intended and associated affects on power and transmission. The replacement of older turbines with more efficient, fish-friendly turbines are intended to benefit hydropower generation as well as fish. Similarly, culvert replacement for improved road access for transmission construction, operation, and maintenance benefit both fish passage and transmission reliability. Transmission reliability is also increased when transmission facilities are made more avian-friendly, reducing the risk to birds and power outages. Negative intended effects include the loss of hydropower generation when water is stored or spilled for fish; and reduced transmission reliability as a result of altered maintenance practices (e.g., reduction in danger tree removal).

Associated effects on power and transmission can be both positive and negative. A positive effect results in increased potential to generate power from reduced spill as juvenile fish transport increases. Another positive associated effect is the promotion and

furthering of the energy conservation and renewable power generation industries as lost hydropower is replaced.[204] However, power replacement utilizing renewables or conservation could result in other negative effects—increased costs and decreased power reliability. Another negative associate effect is the additional infrastructure that would be required, which includes transmission facility, thermal generation, and gas pipeline construction. For example, breaching the four lower Snake River dams would require major changes to the regional transmission system. Also, there would be increased costs associated with deconstruction and building new resources. Further, increasing flows in spring for migrating fish result in a negative associate effect as it creates a surplus of power that is not marketable due to depressed prices. If not used for fish, this water could be stored and used to generate power during times when the electricity market is more favorable.

Transportation

Fish and Wildlife Actions

The types of proposed fish and wildlife actions that would affect transportation include:

- dam breaching or reservoir drawdown;
- dredging restrictions;
- changes in hydrosystem operations for fish;
- substantial changes to juvenile fish migration or transportation; and
- habitat improvements affecting the transportation infrastructure.

Possible Adverse Effects

Possible adverse effects to transportation from fish and wildlife actions include:

- eliminating barging upstream of the last dam breached;
- reduced navigation from seasonal restrictions;
- reduced navigation from decreased channel dredging;
- increased pressure on rail and road infrastructure;
- increased costs as new rail and road capacity would be required;
- increased business failures from high costs associated with shifts in transportation;
- reduced upstream economic activity associated with lost ports;
- impacts to fish transportation expenditures and related industries; and
- decreased transportation or its infrastructure for species or habitat protection.

[204] Energy conservation and renewable power sources would have positive effects on air quality. See the discussion on air quality in this EIS, Section 5.2.3.1.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on transportation as Table 5.2-7 illustrates. The degree of effect is a function of the amount of transportation lost.

Table 5.2-7: Some Factors That Shape Effects on Transportation

Factors Leading to Effect	Effect
Location of the most downstream dam breached or drawn down below MOP	Amount of navigation lost above the breached dam
Availability of alternative transportation and infrastructure	Increased costs of moving goods to market
Dredging restriction in the lower Columbia River	Reduced navigation and increased costs of moving goods to market
Fish transportation strategy used	Changes in navigation
Types of habitat actions implemented	Reduced transportation infrastructure and increased costs to compensate

Possible Mitigation Measures

The types of mitigation measures that might be undertaken to eliminate, reduce, or compensate for adverse effects from fish and wildlife actions include:

- redirecting the focus of port development to areas with higher density rail and road infrastructure;
- shifting to more rail and road based transportation;
- improving port facilities in coastal areas, especially Astoria;
- increasing shallow draft shipping in lower Columbia River;
- maximizing and expanding existing infrastructure and avoiding sensitive habitat areas(e.g. double rails, more lanes); and
- refocusing small business practices to serve the local markets.

Discussion

Fish and wildlife actions can have both intended and associated effects on transportation. Several negative intended effects include reduced navigation as a result of restrictions placed on dredging to benefit fish; and reduced transportation and infrastructure development in sensitive habitat areas. Some positive associated effects on transportation can result from increased fish transport (barging) that could maintain the river for commercial navigation; and increased rail and road development and use if dams are breached severely reducing navigation. However, the increased costs for rail and road infrastructure development and maintenance; increased shipping delays for goods headed to market; and reduced navigation as a result of dam breaching are some of the negative associated effects from fish and wildlife actions.

Agriculture, Ranching, and Forest Products

Fish and Wildlife Actions

The types of proposed fish and wildlife actions that could affect these industries include:

- dam breaching and reservoir drawdown;
- changes in hydrosystem operations;
- habitat improvements affecting land use;
- land retirement programs and restrictions; and
- water quality improvements.

Possible Adverse Effects

Possible adverse effects to agriculture, ranching, and forest products from fish and wildlife actions include:

- paying higher electricity costs for agriculture and ranching operations;
- relocating irrigation diversions as a result of breached dams or reservoir drawdowns;
- impairing groundwater irrigation because of lower water tables after breaching;
- eliminating barging of agricultural products and supplies;
- paying higher costs for transportation of products and supplies;
- losing some agricultural, livestock, and forestry production;
- decreasing the overall land base for agriculture, ranching, and forest products; and
- increasing restrictions on agricultural, grazing, and forestry practices (e.g.; pesticides, herbicides, non-point source runoff, cropping technique).

Context and Intensity

Many factors influence the effects fish and wildlife actions have on agriculture, ranching, and forest products as Table 5.2-8 illustrates. The degree of effect is a function of the amount of production lost or change in practice.

Table 5.2-8: Some Factors That Shape Effects on Agriculture, Ranching, and Forest Products

Factors Leading to Effect	Effect
Locations of dams breached	Reduced irrigation from those reservoirs, increased cost of irrigation modifications, crop or livestock changes
Changes in irrigation technology or deficit irrigation	Changes in the type of crop or crop yield
Increased Power costs	See Table 5.2-5
Increased transportation costs for products and supplies	See Table 5.2-6

Factors Leading to Effect	Effect
Active versus passive restoration	Amount of land removed from production; potential increased risk from human-caused or natural disturbances (e.g., noxious weeds, fire)
Extent to which land retirement programs and restrictions are used for fish and wildlife	Amount and quality of land removed from production, either directly or because of increased cost
Reduced land base and use of traditional practices	Inability to compete in the market; increased production costs
Restrictions on practices that can impact water quality (e.g., pesticides, livestock instream, size of clearcuts)	Increased production risks and costs

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for adverse effects from fish and wildlife actions include:

- installing more efficient irrigation;
- changing to more valuable cash crops, reducing production of low value crops;
- shifting farm production from marginal lands;
- increasing subsidies and monetary incentives for land retirement or water purchase/lease;
- switching to dry land farming or alternative livestock;
- using grazing as a habitat enhancement tool;
- increasing organic farm production;
- better integrating forest management practices and forest product markets;
- focusing on native plants or crops less dependant on chemical application;
- using modern agricultural and forestry practices that preserve or enhance production; and
- for transportation-related mitigation see transportation above.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on agriculture, ranching, and forest products. One positive intended effect could come from the compensation to the farmer, rancher, or forest landowner for land retirement, conservation easements, or water leases. Sometimes these benefits are increased when individuals are compensated for otherwise marginally productive lands. However, there are other intended effects that are negative. These can include the revocation of grazing allotments on public lands, impacts to groundwater and irrigation for agriculture, fencing livestock out of sensitive habitat areas possibly increasing the cost required to construct upland watering areas, and reducing timber harvest. Several positive associated effects on agriculture, ranching, and forest products result from the requirement to develop more efficient and reliable irrigation and increased timber salvage

from efforts to improve habitat, as sound silvicultural and forest management practices (e.g., prescribed burns, select cuts, reducing harvest unit size) are implemented. Negative associated effects from fish and wildlife actions could come from the increase in costs for transporting goods to market, reduced production, changes to dry land farming, increases in crop depredation, and reduced access to resources.

Commercial Fishing

Fish and Wildlife Actions

Any actions that decrease commercial fish populations would affect commercial fishing. The types of proposed fish and wildlife mitigation and recovery actions that could affect commercial fishing include:

- changes in fishing regulations (e.g., reduced season length; alternate-year fishery closures; change in allowable methods, increased escapement goals, size, or location; or more enforcement of existing regulations);
- buy-outs or other payment to limit commercial fishing (fishing effort would be reduced by purchase of the fleet or by payment to not fish at specific times and/or places);
- salmonid predator control (e.g. marine mammals and birds);
- changes in spawning and rearing habitat;
- focusing mitigation and recovery actions on resident fish and wildlife;
- changes in hydrosystem configuration and operation; and
- changes in hatchery practices.

Possible Adverse Effects

Possible adverse effects to commercial fishing from fish and wildlife actions include:

- decreasing catch;
- decreasing revenue;
- increasing costs;
- decreasing ability to cover costs; and
- declining commercial fishing industry.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on commercial fishing as Table 5.2-9 illustrates. The degree of effect is a function of the amount of reduced catch or increased costs.

Table 5.2-9: Some Factors That Shape Effects on Commercial Fishing

Factors Leading to Effect	Effect
Total amount of fish produced (Table 5.2-3), including hatchery-produced and naturally spawning	Amount of fish available for harvest
Amount of allowable incidental take of protected marine mammals	Amount of fish available for harvest
Changes in listed species status	Amount of fish available for harvest
Changes in commercial harvest practices	Amount of fish harvested; costs of fishing, quality and timing of catch
Willingness to sell in a commercial fishing fleet buyout program	Reduction of commercial fleet sizes; impacts on commercial fishing-dependant coastal communities

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for these adverse effects include:

- increasing hatchery production for harvest;
- creating and enforcing international fishing limitations off the Pacific Northwest coast;
- assistance in shifting from commercial to guide-based sport fishing, or other employment;
- providing incentives to modernize commercial fishing fleet; and
- providing compensation for local communities or retraining for displaced fishermen.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on commercial fishing. Most effects are based on the amount of fish available for harvest. As harvest is scaled back, the net effect is increased costs of operation and the downsizing of the commercial fishing fleet. For example, a positive intended effect could be increased numbers of fish for harvest—as a result of increased hatchery production for harvest purposes. However, there may also be negative intended effects as harvest is reduced through increased regulations, such as escapement goals and timing restrictions, to protect listed species. This same dichotomy surfaces in a discussion of positive and negative associated effects. For example, associated effects include the increase/decrease in the economic health of coastal communities (including local support services and the fish processing industry), and the increase/decrease in the size of the commercial fishing fleet. A positive associated effect could also be an increase in the market price for harvested fish, as limited catch results in increased value. However, a negative associated effect is the increase in the cost of the commercial fish operations.

Other Industry

Fish and Wildlife Actions

The types of proposed fish and wildlife mitigation and recovery actions that could affect other industry include:

- dam breaching and reservoir drawdown;
- changes in hydrosystem operations;
- habitat actions targeted at mining practices and mine rehabilitation; and
- actions to reduce point and non-point source pollutants.

Possible Adverse Effects

Some industries, especially the service and government sectors, would not likely be as affected as natural resource-based industries from actions taken to benefit fish and wildlife. Possible adverse effects to other industry[205] from fish and wildlife actions include:

- increased electricity prices, particularly the direct service aluminum industry;
- restrictions on mine access and water quality resulting in high operating costs;
- increased pollution control costs; and
- increased raw materials (e.g., sand and gravel, wheat, wood pulp, apples) and transportation costs.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on other industry as Table 5.2-10 illustrates. The degree of effect is a function of the amount of increased costs of operations or raw materials.

Table 5.2-10: Some Factors That Shape Effects on Other Industries

Factors Leading to Effect	Effect
Intensity of the habitat actions	Less raw material available increasing costs; increasing operation costs; less water available for industrial processes
Amount of hydropower lost	Increased costs of electricity and transportation
Level of incentives to reduce production of raw materials	Less raw material available increasing costs
Amount and enforcement of pollution control regulations	Increasing operation costs to treat water
Amount of transportation lost to dam breaching	Increased costs of transportation for raw materials and industrial products

[205] Adverse effects are listed primarily for those natural resource-based industries.

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for these adverse effects include:

- developing least cost replacement power;
- improving road and rail transportation;
- developing less environmentally damaging and cost-effective mining practices; and
- providing incentives for improving waste water treatment.

For a discussion on raw material production (other than mining) see the Agriculture, Ranching, and Forest Products section above.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on other industry. Many of these industries are dependent on water, energy, and raw materials. Therefore these industries would be affected by environmental requirements and changes in power, water, and raw material availability. Positive intended effects can include compensation through buyout programs for marginal business and financial incentives for developing and installing better technology and reducing pollution. Negative intended effects include the restrictions, limitations, or reductions of mining (e.g., sand and gravel, gold, silver), raw material production, and wastewater discharge. Positive associate effects of fish and wildlife actions on other industry include increased efficiency through forced cost cutting and technological improvements, increased profit when perceived as a "green" industry, and reduced competition as other competing businesses fail. However, increased costs of operations, transportation, and raw material availability are negative associated effects. In particular, increased costs of operations can arise from the loss of inexpensive hydropower. Any increased costs could force marginal industries into bankruptcy.

Recreation

Fish and Wildlife Actions

The types of proposed fish and wildlife mitigation and recovery actions that could affect recreation include:

- dam breaching and reservoir drawdown;
- changes in hydro operations;
- changes in recreational fishing and hunting regulations;
- implementing predator control programs;
- changes in hatchery practices;
- limiting access to protect habitat and listed species; and
- reestablishing native fish and wildlife species.

Possible Adverse Effects

Possible adverse effects to recreation from fish and wildlife actions include:

- eliminating most flatwater recreation on the reservoir where breaching or drawdown occur, including activities such as fishing, boating, and water skiing; related supporting facilities would be closed or relocated;
- decreasing warm water fishing opportunities;
- reducing fishing, hunting, and other recreational opportunities as changes in hydro operations result in water fluctuations;
- reducing recreational harvest levels or species allowed to be harvested through changes in fishing and hunting regulations;
- decreasing hatchery fish available for recreational harvest;
- exposing potential hazards as water levels are lowered;
- separating, visually and physically, land-based recreation from water, such as camping and picnicking;
- increasing risks to swimmers and watercraft operated from increased water velocity;
- limiting recreational development in sensitive habitat areas (e.g., ski resorts);
- reducing water availability to developed recreation (e.g., golf course, resorts);
- limiting or restricting access resulting in crowding in other recreational areas;
- limiting access to areas used for dispersed recreation; and
- reducing the economic value of recreational fishing and hunting, as well as other outdoor recreation activities and support services.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on recreation as Table 5.2-11 illustrates. The degree of effect is a function of the amount of available recreational opportunities.

Table 5.2-11: Some Factors That Shape Effects on Recreation

Factors Leading to Effect	Effect
Amount of hatchery production to support recreational fishing	Amount of fish available
Variety of harvestable fish and wildlife species	Amount of loss fishing and hunting opportunities
Amount of water level and flow fluctuations from changes in hydro operations	Amount of flatwater and riverine recreation available; amount of warm water fishing available; amount of access to fishing and other recreational sites
Where dams are breached	Amount of flatwater and riverine recreation available; amount of warm water fishing available; amount of access to fishing and other recreational sites

Factors Leading to Effect	Effect
Amount of habitat set aside for fish and wildlife	Decreased opportunities for dispersed recreation such as hiking and bird watching

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for these adverse effects include:

- developing or improving alternative recreational opportunities;
- developing floating boat facilities instead of fixed facilities to address water level fluctuations;
- using formerly inundated lands for recreational purposes;
- establishing user levels to avoid overcrowding at certain recreational sites;
- relocating and adapting recreational facilities for altered environments (e.g., as reservoirs are drawn down refocus to more riverine recreation);
- allowing special hunts to offset reduced harvest levels;
- establishing a naturally spawning fish recreational harvest in the long term;
- targeting recreational development in marginal habitat areas or along habitat edges; and
- constructing more environmentally-friendly recreational facilities (smaller footprint).

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on recreation, including both sport fishing and hunting and other types of recreation. One positive intended effect to fishing and hunting comes from increases in hatchery and other stocking programs for fish and wildlife. However, altering the hatchery program or otherwise reducing harvest is a negative intended effect. Another negative intended effect on recreation is the limitations on access and development of recreational areas, as sensitive habitat is protected. Positive associated effects for fishing and hunting can result from incentive-based predator or nuisance species control programs, such as the pikeminnow program. Other positive associated effects include potential increases in riverine recreation development if dams are breached and increased water velocity for boaters (e.g., kayaking, rafting) as flows are increased for fish. However, increased flows can result in the negative associated effect by presenting hazards to swimmers or other boat users. Other negative associated effects include reduced land-based recreation and its proximity to water; reduced water-based recreation as a result of dam breaching; diminished quality of the recreational experience due to crowding; and loss of local recreation-based economy.

Industrial, Residential, and Commercial Development

Fish and Wildlife Actions

The types of proposed fish and wildlife mitigation and recovery actions that could affect industrial, residential, and commercial development include:

- dam breaching and reservoir drawdown;
- decreases in commercial harvest or changes in hatchery production;
- protecting sensitive habitat areas for fish and wildlife; and
- requiring point and non-point source pollution controls.

Possible Adverse Effects

Possible adverse effects to industrial, residential, and commercial development from fish and wildlife actions include:

- limitations in location, size, and type of development;
- reduced new development in ports near breached dams;
- increased costs of electricity;
- decreased water availability for new development;
- reduced development in areas dependant on commercial fishing;
- reduced development in areas dependant on the forest products industry;
- reduced development in areas dependant on recreation; and
- reduced development from increased costs for pollution abatement.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on industrial, residential, and commercial development as Table 5.2-12 illustrates. The degree of effect is a function of the amount of restrictions placed on development.

Table 5.2-12: Some Factors That Shape Effects on Industrial, Residential, and Commercial Development

Factors Leading to Effect	Effect
Which dams are breached or reservoirs drawndown	Development and land use patterns
Amount of increase in electricity and water costs	Increase costs of development
Amount of hatchery production for recreational fishing	Reduced development in areas that support recreational fishing
Amount of commercial harvest	Reduced development in communities dependant of the fishing industry
Habitat actions that set aside land	Reduced development potential

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for these adverse effects include:

- support energy and water conservation program;
- provide incentives for "green" development;
- increase development in coastal communities focusing on tourism;
- encourage cogeneration; and
- increase new development in areas that become new termini for navigation and transportation.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on industrial, residential, and commercial development. A negative intended effect on development occurs when actions taken to preserve or protect sensitive habitat areas limit or restrict new development. However, this limitation on development can have a positive associated effect for the landowners, who are not affected by the new land use restrictions and can develop in adjacent areas. The value of the adjacent land can be higher due to the limited development in the area. Increased hatchery construction to meet fish production goals is another positive associated effect on development. As fish numbers increase allowing more commercial and recreational harvest, development will also increase. For example, as commercial harvest increases, the coastal communities dependant on the industry will become more developed. However, decreased fish production or harvest levels will have the opposite effect. Other negative associated effects include the increase in development costs due to higher electricity rates and water availability, and decreases in the development potential of property that had once been waterfront before dam breaching.

Employment and the Regional Economy

Regional economic effects vary from locale to locale. These effects can have disproportionate impacts on rural communities. For example, a decrease in timber receipts from Federal lands can detract from funding for local county roads and public schools. Effects from fish and wildlife mitigation and recovery actions would be felt in the area where the action takes place or by a particular economic sector. Fish and wildlife actions that impact irrigation, either through lowered reservoirs or required changes in technology, would disproportionately affect rural areas and irrigated agriculture. While habitat actions that restrict access or timber harvest would impact the forest products industry and the local economies that depend on it. This also holds true for commercial fish harvest and the impacts that changes in harvest management would have both on the industry and coastal communities. Other actions could affect the entire Region. For example, impacts from fish and wildlife actions on navigation and electricity rates would have effects across economic sectors. Overall, actions that would affect these economies would also affect employment. Although there may be some increases in employment as personnel are required to carry out fish and wildlife actions,

it would likely not offset the overall effects of the actions on local and regional employment.

These employment effects would be felt more by low-income or minority populations, including tribal populations. For example, effects on agriculture would impact seasonal farm workers more than those employed year-round. Also, decreases in fish harvest would more adversely affect tribal and low-income workers in coastal communities. Further, increases in electricity rates would have large impacts on low-income families, as the electric bill becomes a larger portion of their income. In general, reduced employment and income could further impact these workers, their families, and their health.

For more information on the generic effects from fish and wildlife actions on the economic environment see specific sections above.

Funding Costs

For a discussion of the effects of funding costs for fish and wildlife on ratepayers, taxpayers, and others, and possible mitigation measures see Section 2.3.2.3 Current Policies—Conflicting Priorities: Challenges to Funding.

5.2.3.3 Social Environment

Actions taken for fish and wildlife affect the social environment. Those areas most affected by fish and wildlife actions include:

- Tribal Interests,
- Cultural and Historic Resources, and
- Aesthetics.

Tribal Interests[206]

This section is concerned with the potential adverse effects of mitigation and recovery actions taken for fish and wildlife on tribal members and communities. This section intends to cover the unique relationships tribal members have with the environment.

Fish and Wildlife Actions

The types of proposed fish and wildlife actions that could affect tribal interests include:

- dam breaching and reservoir drawdown;
- changes hydrosystem operations;
- changes in fish harvest allocation;

[206] Considerable analysis has been conducted in the Lower Snake River Feasibility Study (Corps 2002b) and its Drawdown Regional Economics Workgroup (Corps 199a) and a report on tribal conditions titled "Tribal Circumstances and Perspective Analysis of Impacts of the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes" (Corps 1999c). Additional analysis is available in the Framework Report (Council 2000a).

- regulatory changes in fish and wildlife management;
- changes in hatchery use and operations; and
- habitat improvement or protection actions.

Possible Adverse Effects

The types of adverse effects from fish and wildlife actions on tribal interests include:

- increased exposure of cultural resources from breaching or drawdown;
- decreased resident or anadromous fishing opportunities/harvest;
- exposure to toxic materials from sediments (e.g., mercury bioaccumulation); and
- decline of practices essential to the preservation of tribal culture, tradition, and spirituality.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on Native American Indians as Table 5.2-13 illustrates. The degree of effect is a function of the extent to which Native American Indian interests are impacted. These interests relate to tribal fish harvest, tradition, spirituality, and health. Tribal interests also include areas such as water quality, preservation of cultural and historic resources, and socioeconomic concerns such as employment and income; however, these areas are discussed separately in other sections of this chapter.

Table 5.2-13: Some Factors That Shape Effects on Native American Indians

Factors Leading to Effect	Effect
Fluctuations in the total amount of natural resources available for Native American Indian use	Changes in tribal harvest, traditional practices, and economic and social values of resources available to Native American Indians
Fluctuations in reservoir levels	Loss of cultural resources as they are exposed and damaged
Type and amount of hatchery production	Changes in fish harvest levels
Changes in total available harvest/catch limits	Amount of allowable harvest allocated to tribal members
Changes in fish and wildlife laws and policies, or their implementation	Changes in tribal harvest and harvest methods, traditional practices, and economic and social values

Possible Mitigation Measures

The types of measures that might be undertaken to mitigate for adverse effects from fish and wildlife actions include:

- providing increased security and protection for exposed culturally important sites;
- minimizing reservoir fluctuations to reduce exposure of cultural resources and toxic sediment;
- increasing hatchery production;

- increasing tribal fish harvest allocation;
- substituting resident fish for anadromous fish; and
- improving tribal access and control of areas of cultural and spiritual importance.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on tribal interests. For example, increases in hatchery production can result in the intended positive effect of increased fish for ceremonial and subsistence uses. A negative intended effect could include decreased fish and wildlife harvest as a result of changes in harvest allocation and regulations. Positive associated effects can include increased tribal health and the facilitation of traditional tribal practices, as more fish are available for harvest. However, negative associated effects can result in decreases in tribal health from potential toxic sediment releases and bioaccumulation in fish; and the loss of important cultural resources from reservoir fluctuations or dam breaching. Changes in the available amounts for fish and wildlife funding, or in the locations where that funding gets used, can also result in negative effects on those tribes that have come to rely on fish and wildlife funding.

Effects can also stem from decisions over whether to manage for anadromous or resident fish. In some areas the resident fishery may be reduced as the focus is placed on anadromous fish. However, in other areas, resident fish may be used as substitution for lost anadromous fish. These choices can have profound effects, both intended and associated, on tribes depending on the value (tradition or spiritual) each tribe places on the fish.

Cultural and Historic Resources

Fish and Wildlife Actions

The types of proposed fish and wildlife actions that could affect cultural and historic resources include:

- dam breaching and reservoir drawdown;
- changes in hydrosystem operations;
- habitat enhancement activities;
- hatchery construction;
- dam modifications for fish (e.g. spillways, turbines, fish passage); and
- restricting access to sensitive habitat areas.

Possible Adverse Effects

The types of adverse effects from fish and wildlife actions on cultural and historic resources include:

- exposure of cultural and historic resources;
- inundation of cultural and historic resources

- loss or damage of cultural and historic resources through disturbance, removal, or vandalism; and
- access restrictions to important cultural and historic resources.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on cultural and historic resources as Table 5.2-14 illustrates. The degree of effect is a function of the number of cultural and historic resources impacted by the fish and wildlife actions.

Table 5.2-14: Some Factors That Shape Effects on Cultural and Historic Resources

Factors Leading to Effect	Effect
Extent of the shoreline exposed from dam breaching or reservoir drawdown	Number of sites subject to exposure and damage
Amount of changes in reservoir levels and flow from changed hydro operations	Number of sites subject to exposure and damage
Amount of time a resource is exposed	Increased opportunity for the resource to be damaged or destroyed
Which dam is breached or modified	Potential loss of a historic site
Amount and location of habitat protected	Amount of access restricted to cultural and historic resources

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for these adverse effects include:

- minimizing reservoir fluctuations to reduce erosion and exposure of sites;
- inventorying, recording, and protecting cultural and historic resources where fish and wildlife action may affect them;
- increasing enforcement to protect historic and cultural resources from inadvertent or intentional disturbance or destruction; and
- providing limited, controlled access to important cultural and historic resources.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on cultural and historic resources. A negative intended effect arises when dam are modified, removing or altering machinery or structures that are considered historic resources. A positive associated effect can result from the protecting of sensitive habitat for fish and wildlife thereby protecting any cultural or historic resources located there. Other positive associated effects can include the restoration of or improved access to cultural sites, and the ability to study previously undocumented sites. However, access to cultural or historic sites may be restricted to protect sensitive habitat areas, resulting in negative associated effects. Other negative associated effects include the damaging of resources from exposure, theft, or vandalism due to changes in hydro operations or

construction activities; and increased disturbances due to increase human presence as fish and wildlife populations increase or access to other areas is restricted.

Aesthetics

Fish and Wildlife Actions

The types of proposed fish and wildlife actions that could affect aesthetics include:

- dam breaching and reservoir drawdown;
- wildlife range burning;
- access restrictions for sensitive habitat areas;
- salmon carcass nutrient supplementation;
- habitat enhancement and land retirement; and
- water acquisitions for fish.

Possible Adverse Effects

The types of adverse effects from fish and wildlife actions on aesthetics include:

- unsightly reservoir sediment and debris;
- malodorous water;
- increased number of decaying fish;
- increased noise and dust from dam deconstruction in the short-term;
- reduced visibility from smoke;
- unsightly burned areas; and
- limited access to aesthetically-pleasing areas.

Context and Intensity

Many factors influence the effects fish and wildlife actions have on aesthetics as Table 5.2-15 illustrates. The degree of effect is a function of the extent of impact on aesthetics by fish and wildlife mitigation and recovery actions.

Table 5.2-15: Some Factors That Shape Effects on Aesthetic Resources

Factors Leading to Effect	Effect
Amount of the shoreline exposed from dam breaching or reservoir drawdown	Amount of sediment and debris exposed, degree of odor, amount of windblown sediment
Amount of changes in reservoir levels from changed hydro operations	Level of turbidity, odor, exposed shoreline
Which dam is breached or modified and access to visitors	Size of the aesthetic impact, number of people impacted
Number of salmon carcasses added to river	Increased visual and odor impacts
Size of area burned for wildlife, or sediment exposed to wind erosion	Increased air pollution, regional haze, decreased visibility

Factors Leading to Effect	Effect
Amount of habitat enhancement or land retirement	Increased amount of "naturally-appearing" landscape
Amount of water acquired for fish	Improved riverine appearance
Amount and location of habitat protected	Amount of access restricted to aesthetic areas

Possible Mitigation Measures

The types of mitigation that might be undertaken to eliminate, reduce, or compensate for these adverse effects include:

- reseeding and revegetating exposed reservoir bottoms and shorelines;
- limiting the size of the burned area;
- timing (e.g. weather conditions) burning to avoid impacts;
- allowing limited, controlled access in sensitive areas;
- developing new viewpoints; and
- selective timing and placing of salmon carcasses.

Discussion

Fish and wildlife mitigation and recovery actions can have both intended and associated effects on aesthetics. A negative intended effect can be the restricting of human access to areas of aesthetic value as sensitive habitat areas are protected. Positive associated effects from fish and wildlife actions can include increased visual appearance—"natural" looking landscape—from protecting and enhancing lands that were previously disturbed; or through passive or active restoration of lands previously inundated; increased recreation; viewing of new renewable resource technology (winds turbines). Renewable power sources, such as wind, as an alternative to CTs for replacing lost hydropower would not contribute to visibility impacts (regional haze). Negative associated effects to aesthetics include exposed sediment and windblown dust, in the short term from dam breaching or range burning; and increased air emissions if CTs or other thermal resource replace lost hydropower, and from increased truck or rail traffic from decreased navigation. Exposed sediments and debris from dam breaching; burned areas; intrusion of wind turbines; and odors from smoke, exposed mudflats, and decaying vegetation and fish can also be short-term negative associated effects. Finally, as access is limited to certain sensitive habitat areas, the negative associated effect to aesthetics will result from the overcrowding of other areas and the associated increases in noise.

5.2.3.4 Summary of Generic Effects

The following figures summarize some of the generic effects discussed above. The first set of figures (Figures 5-8 – 5-15) displays the effects of human activities on fish and wildlife and their habitats. The human activities shown are those that received the most attention during the public meetings. The second set of figures (Figures 5-16 – 5-19) depicts the effect actions taken for fish and wildlife have on the economic and social environments. These fish and wildlife actions are divided into four categories—habitat, hatchery, harvest, and hydro.

Figure 5-8: Potential Effects from Forestry (including timber harvest) on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality
- Increased erosion rates
- Direct loss or alteration of habitat

Mitigation measures
- Immediate reseeding/revegetation
- Shift to ecosystem management approach
- Manage noxious weeds

Possible adverse effects
- Deterioration of water quality
- Alteration of water velocity and flow
- Loss of water habitat (riverine, riparian, etc)

Mitigation measures
- Sustainable silviculture techniques on waterway/land interfaces
- Reduce sedimentation, temp., water withdrawals, irrigation return flows
- Reduce non-thermal pollution
- Leave large woody debris

Possible adverse effects
- Loss of and/or disturbance to both fish and wildlife

Mitigation measures
- Preservation of forest lands and stream corridors
- Modify harvest practices to develop and utilize sustainable silviculture techniques
- Manage controlled and prescribed burns
- Manage un- and desirable exotic species
- Control access to forest roads

Figure 5-9: Potential Effects from Agriculture (including grazing) on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality (eg. Use of pesticides and herbicides)
- Loss of habitat

Mitigation measures
- Modify cultivation and management practices (conservation, no-till, shifting crops)
- Reduce or eliminate chemical usage
- Create microhabitats

Possible adverse effects
- Deterioration of downstream quality
- Alteration of water velocity and flow
- Loss of water habitat (riverine, riparian, etc)
- Alter/contaminate water tables
- Alteration of base flows
- Withdrawals reduce threshold quantity

Mitigation measures
- Reduce allowable water withdrawals
- Retire/fallow irrigated land
- Modify/adopt irrigation conservation techniques
- Reduce non-thermal pollution
- Reduce/restrict chemical usage
- Fence livestock out of riparian areas

Possible adverse effects
- Loss of and/or disturbance to fish and wildlife
- Competition for food and space with livestock

Mitigation measures
- Develop small ponds to retain water
- Shift to sustainable livestock grazing practices
- Plant wildlife food plots

Figure 5-10: Potential Effects from Mining on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality
- Loss of habitat

Mitigation measures
- Reclaim and restore habitat destroyed by mining
- Use BMP (best management practices) for mining

Possible adverse effects
- Deterioration of habitat quality
- Alteration of water velocity and flow Loss of water habitat (wetland, riparian, etc)

Mitigation measures
- Prohibit/minimize mining activities on lands adjacent to water bodies or sensitive/riparian areas.
- Improve wastewater treatment

Possible adverse effects
- Loss of and/or disturbance to fish and wildlife

Mitigation measures
- Eliminate mining in riparian areas; reclaim and restore habitat already destroyed
- Prohibit/minimize surface mineral, oil, gas, geothermal exploration/development activities
- Prohibit mining upstream of spawning and rearing areas

Figure 5-11: Potential Effects from Recreation on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality
- Direct loss and/or disturbance to wildlife habitat

Mitigation measures
- Maintain wetlands
- Control intensity and rotate use

Possible adverse effects
- Deterioration of habitat quality
- Alteration of water velocity and flow

Mitigation measures
- Manage spread of exotic species
- Restrict/reduce availability (i.e. golf courses)

Possible adverse effects
- Loss of and/or disturbance to fish and wildlife (I.e. disease,exotics)
- Artificial selection/breeding, leading to long-term genetic changes in stocks
- Introduction of exotic species

Mitigation measures
- Improve/change hunting/fishing/poaching regulations and enforcement
- Locate recreational activities away from fish and wildlife habitat
- Educate public
- Manage exotic species
- Evaluate and modify hatchery production

Figure 5-12: Potential Effects from Industrial, Residential, and Commercial Development on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality
- Direct loss and/or disturbance to wildlife habitat

Mitigation measures
- Erosion management (i.e. land contouring)
- Incentives for "green" sustainable development

Possible adverse effects
- Decline in water quality (I.e. runoff of toxins, wastes)
- Lowered water tables
- Withdrawals reduce flow and quantity

Mitigation measures
- Effective stormwater collection infrastructure and management
- Improve/change regulations and enforcement of discharged waters
- Conservation and education programs

Possible adverse effects
- Loss of and/or disturbance to fish and wildlife (i.e.. roads, fill)
- Reduced habitat connectivity
- Decreased food sources

Mitigation measures
- Restrict development and/or obtain easements of sensitive habitats
- Limit/change land use practices (i.e. .restrict/capture runoff, "fireproofing")
- "Green" (sustainable) development
- Conscientious design/placements of roads
- Manage exotic species

Figure 5-13: Potential Effects from Transmission Facilities on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality
- Direct loss and/or disturbance to wildlife habitat

Mitigation measures
- Immediate reseeding/vegetation
- Non-chemical vegetation management
- Install low maintenance transmission facilities

Possible adverse effects
- Deterioration of habitat quality
- Alteration of water velocity and flow

Mitigation measures
- Span lines over sensitive aquatic areas
- Maximize use of existing right-of-ways and access roads
- Avoid riparian, wetland and sensitive areas

Possible adverse effects
- Loss of and/or disturbance to fish and wildlife

Mitigation measures
- Conscientious design/placements of roads
- Schedule maintenance/repair around sensitive species' critical time
- Develop and implement avian protection practices

Figure 5-14: Potential Effects from Hydro Power Operations on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality
- Inundation of land
- Increased erosion rates
- Direct lost or alteration of habitat

Mitigation measures
- Minimize fluctuations in reservoir levels

Possible adverse effects
- Deterioration of quality
- Alteration of water velocity and flow
- Loss of reservoir habitat due to hydro

Mitigation measures
- Decrease nitrogen supersaturation
- Decrease temperature
- Increase turbine efficiency

Possible adverse effects
- Loss of and/or disturbance to fish and wildlife
- Impediments to fish passage
- Alter migration patterns
- Exposure to toxic sediments (bioaccumulation)

Mitigation measures
- Decrease nitrogen supersaturation
- Reduce water temperature
- Improve fish passage including transportation
- Increase spill
- Breach dams

Figure 5-15: Potential Effects from Non-Hydro Energy Resources on Fish and Wildlife

Possible adverse effects
- Decreased habitat quality (eg. greenhouse gases, particulate matter, haze)
- Increased potential for acid rain

Mitigation measures
- BACT (Best available control technology)
- Increase power imports/decrease power exports
- Conservation programs
- Locate facilities near available transmission capacity
- Maximize use of existing rights-of-way

Possible adverse effects
- Deterioration of water quality
- Alteration of water velocity and flow

Mitigation measures
- Conscientious siting of facility
- Energy conservation programs/reduce energy consumption
- Improve wastewater treatment

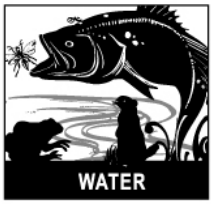
Possible adverse effects
- Loss of and/or disturbance to both habitat and wildlife

Mitigation measures
- Conscientious placement of facility
- Energy conservation programs/reduce energy consumption
- Encourage cogeneration and renewable resources
- Develop and implement avian protection plans

Figure 5-16: Examples of Habitat Actions and Adverse Effects on the Economic and Social Environments

Fish and Wildlife Actions

- Habitat protections and improvements affecting transportation infrastructure
- Habitat improvements affecting land use
- Land retirement programs and use restrictions
- Habitat actions targeted at mining practices and mine rehabilitation
- Access limitations in protected habitat
- Wildlife range burning



- Dredging restrictions
- Water quality improvements
- Actions to reduce point and non-point source pollution
- Access limitations in protected habitat
- Water acquisitions for instream use

- Re-establishing native fish and wildlife species
- Salmon carcass nutrient supplementation

Socioeconomic Effects

Possible adverse effects
- Reduced navigation
- Restrict transportation improvements
- Decreased agricultural and forest product production
- Increased operating and raw material costs
- Reduced recreation opportunities
- Reduced economic value of recreation
- Limitations on development

Mitigation measures
- Maximize existing right of ways
- Use low maintenance transmission facilities
- Strategic port development
- Improve rail and road transportation
- Increase subsidies for land retirement/ water purchase/lease

Possible adverse effects
- Decline of traditional practices
- Reduced access to traditional lands

Mitigation measures
- Fund tribal participation in federal processes
- Provide increased hunting, fishing, and gathering opportunities

Possible adverse effects
- Loss or damage of resources through disturbances, removal, and vandalism
- Restricted access to important cultural and historic sites

Mitigation measures
- Provide security, protection and/or limit access to sites
- Tribal access to/control of cultural areas
- Inventorying and recording cultural and historic sites

Possible adverse effects
- Malodorous water and air
- Increased number of decaying fish
- Reduced visibility from smoke
- Access limitations to aesthetically-pleasing areas
- Unsightly burned areas

Mitigation measures
- Reseeding/revegetation
- Control size and timing of burning
- Limited, controlled access to sensitive areas

Figure 5-17: Examples of Harvest Actions and Adverse Effects on the Economic and Social Environments

Fish and Wildlife Actions

- Restrict access to hunting and fishing sites

- Restrict access to hunting and fishing sites

- Changes in commercial fishing regulations
- Fishing fleet buyout program
- Predator control program
- Changes in spawning and rearing habitat
- Prioritizing mitigation and recovery to benefit resident fish and wildlife
- Changes in fishing and hunting regulations
- Changes in tribal fish harvest allocation

Socioeconomic Effects

Possible adverse effects
- Decreased commercial harvest
- Increased costs
- Declining commercial fishing industry
- Reduced recreational harvest
- Reduced economic value of recreational fishing
- Reduced development in areas dependant on commercial fishing

Mitigation measures
- Increase hatchery production
- Create/enforce international fishing restrictions
- Provide retraining and job placement
- Provide incentives to modernize fleet
- Create alternative recreational opportunities

Possible adverse effects
- Decreased harvest
- Decreased health
- Decline of traditional practices
- Reduced spirituality

Mitigation measures
- Increase hatchery
- Create/enforce international fishing restrictions
- Increase tribal fish allocation
- Substitute resident fish for anadromous

Figure 5-18: Hatchery Actions and Adverse Effects on the Economic and Social Environments

Fish and Wildlife Actions

- Hatchery construction/deconstruction

- Reforming hatchery production
- Hatchery closures
- New hatchery construction

Socioeconomic Effects

Possible adverse effects
- Decreased fish available for commercial and recreational harvest
- Reduced economic value in commercial and recreational fishing

Mitigation measures
- Increase hatchery production for harvest
- Create/enforce international fishing restrictions
- See examples of Harvest mitigation measures

Possible adverse effects
- Reduced harvest
- Reduced spirituality from loss of wild fish
- Reduced health

Mitigation measures
- Preserve wild fish
- Transfer some hatchery operations to tribes
- Increase tribal fish allocation
- Substitute resident fish for anadromous
- Create/enforce international fishing restrictions

Possible adverse effects
- Malodorous air from presence of hatchery

Mitigation measures
- Siting away from human activities

Figure 5-19: Examples of Hydro Actions and Adverse Effects on the Economic and Social Environments

Fish and Wildlife Actions

- Dam breaching and reservoir drawdown
- Increase spill
- Changes in hydrosystem operations
- Dam and facility modifications
- Water quality improvements

- Changes to juvenile fish migration and transportation
- Changes to adult fish passage
- Predator control/deterrent

Socioeconomic Effects

Possible adverse effects
- Increased power costs
- Decreased power and transmission generation and reliability
- Reduced navigation
- Limits development
- Reduced economic activity associated with ports
- Loss of irrigation
- Reduced recreation opportunities
- Reduced economic value of recreation

Mitigation measures
- Increase energy efficiency programs
- Develop new energy resources
- Improve rail and road transport
- Install efficient irrigation
- Use more sustainable agricultural
- Create alternative recreation opportunities

Possible adverse effects
- Health impacts from bioaccumulated fish
- Decreased fishing opportunities
- Decline of traditional practices

Mitigation measures
- Minimize reservoir fluctuations
- Increase tribal fish allocation
- Improve tribal access to areas with spiritual importance

Possible adverse effects
- Exposure or inundation of cultural/historic resources
- Loss or damage of resources through disturbances, removal, and vandalism

Mitigation measures
- Provide protection and/or limit access to sites
- Minimize reservoir fluctuations
- Tribal access to/control of cultural sites
- Reseeding/revegetation of reservoir bottoms and shorelines

Possible adverse effects
- Unsightly and malodorous reservoir sediment and debris
- Increased short term noise and dust from dam construction

Mitigation measures
- Reseed/revegetate reservoir bottoms and shorelines

5.3 ENVIRONMENTAL CONSEQUENCES OF POLICY DIRECTIONS

This EIS is very broad in coverage, focusing on effects of fish and wildlife mitigation and recovery activities on the natural, economic, and social environments within the Pacific Northwest. The types of activities considered in this analysis are derived from the categories of actions discussed in Section 5.2.1.1: *habitat, harvest, hatcheries,* and *hydro*. The effects of these activities are evaluated over a range of reasonably foreseeable Policy Directions. These Policy Directions, as discussed in Chapter 3, encompass a broad spectrum of regional plans and processes for fish and wildlife mitigation and recovery. The analysis considers both short-term and long-term effects.

5.3.1 Framework for Analysis

As previously discussed, Section 5.1 describes the existing conditions of the affected environment. Section 5.2 evaluates the natural, economic, and social environments in terms of the generic environmental effects that human activities have on fish and wildlife, and the generic environmental effects that fish and wildlife activities have on humans. Section 5.3 is the detailed analysis of the environmental consequences of implementing the alternative Policy Directions. Each Policy Direction is evaluated based on its effects on the natural, economic, and social environments.

The five alternative Policy Directions evaluated in this section include:

- Natural Focus,
- Weak Stock Focus,
- Sustainable Use Focus,
- Strong Stock Focus,
- Commerce Focus.

For a description of each Policy Direction see Section 3.2.

These alternative Policy Directions span a full range of reasonably foreseeable future directions for fish and wildlife policy in the Region. This range includes Policy Directions that may be perceived as more favorable for fish and wildlife as well as those that may be perceived as more favorable to people, from the standpoint of economics and social well-being. Therefore, for any Policy Direction, the same environmental consequences may be both beneficial and adverse, depending on the perspective. The reader is provided with a description of the effects associated with each Policy Direction.

5.3.1.1 A Comparison to Status Quo

Status Quo (the "No Action" alternative) represents a continuation of the policy direction that the Region appeared to be following before 2002. Under Status Quo, there is no comprehensive and consistent policy to guide fish and wildlife mitigation and recovery activities. For a description of Status Quo see Section 3.2.1. The alternative Policy

Directions share many of the same attributes as Status Quo; however, these other alternatives are based on a unified planning approach. Status Quo provides the baseline against which all the alternative Policy Directions are compared.

5.3.1.2 A Relationship Approach

By design the analysis in this EIS is more qualitative than quantitative—it is a policy-level evaluation, not a site-specific one. Therefore, the analysis is based on predictable *relationships* between changes to the environment (air, land, and water) and the consequences for fish, wildlife, and humans. The overall intent is to align the level of decisionmaking with the appropriate level of analytical detail so that the public and decisionmakers can better understand the range of potential effects at each stage of decisionmaking. Once a Policy Direction is selected, any necessary site-specific analysis will be carried out when the actual implementation actions for the chosen Policy Direction are known. At that time, any new scientific or other relevant information will be incorporated into the site-specific analysis. This clarifying information could then be documented and tiered to the overall Policy Direction decision, as appropriate. The objective is to inform the public and decisionmakers. This approach should provide the document with extended usefulness, as values and priorities change over time.

5.3.1.3 An Environmental Analysis

The objective of this analysis is to describe the expected environmental conditions under the possible range of implementing actions for fish and wildlife mitigation and recovery under each Policy Direction. The comparisons of the alternative Policy Directions with Status Quo are meant to show how the environmental consequences of each Policy Direction may differ from conditions under the Status Quo Policy Direction. The analysis is organized by the following effect areas:

- Air Quality,
- Land Habitat,
- Water Habitat,
- Fish and Wildlife,
- Commercial Interests,
- Recreation,
- Economic Development,
- Funding Costs,
- Tribal Interests,
- Cultural and Historic Resources, and
- Aesthetics.

Each of these broad effect areas is further broken into subcategories in the analysis.

For each effect area category or subcategory, the affected environment is briefly summarized in terms of existing conditions (for a more complete description of the affected environment see Section 5.1). Next, the environmental conditions under the Status Quo Policy Direction are briefly described. Then, the environmental conditions under each of the alternative Policy Directions are described. The environmental effects analysis considers both the short and long terms. The short term includes those effects likely to occur within 10 years (major short-term effects will be examined in greater detail in future project-specific tiered environmental analyses). The long term generally extends beyond the 10-year period. The environmental effects are described in terms of "better", "worse", or the "same" as Status Quo. The terms "better" or "worse" are equivalent to the NEPA terms "beneficial" and "adverse."

At the beginning of each effect area, a summary is provided to briefly describe the environmental consequences of each alternative Policy Directions. Each effect area is first summarized in a table, broken down by the environmental consequences on each subcategory, when applicable. Shading is used to quickly show the reader whether the Policy Direction results in *much worse, worse, the same, better or much better conditions* relative to the Status Quo policy. The ratings were assigned through a modified Delphi process using a panel of experts.[207] In the natural environment, the environmental consequences are described in terms of the effects on fish and wildlife. In the economic and social environments, the human perspective is considered in describing the environmental consequences. Following each table, the environmental consequences are summarized by Policy Direction.

5.3.1.4 The Sources for Analysis

The use of multiple sources has been critical to the qualitative analysis used in this EIS. Over the last several years, an enormous database of environmental analyses has been created. In this EIS, the use of this existing database was maximized. Many environmental documents have been incorporated by reference. These important sources include the Columbia River SOR EIS, the Lower Snake River Juvenile Migration Feasibility Report/ EIS, the Forest Service/BLM's Interior Columbia Basin EIS, and BPA's Business Plan EIS. For more information on these and other environmental documents see Section 1.3.3. Other important sources include the Council's Fish and Wildlife Program, NMFS and USFWS BiOps, John Day Drawdown Phase I Study, and reports from the Multi-Species Framework Process and Federal Caucus. These sources are described in Section 1.3.2. For a more technical evaluation, please refer to these documents, including their respective appendices. The analysis was further aided by the comments received from around the Region during the preparation of this EIS.

Many of these studies and processes are complex and often subjective. The lack of concurrence regarding basic assumptions, methodology, and analysis (including various models) have led to often conflicting and biased conclusions. Therefore, it is difficult to

[207] Charles Alton, Jean Edwards, Steve Mader, Roger Mann, Michael Mayer, Kathy Pierce, John Pizzimenti, and Ben Underwood. See List of Preparers for backgrounds.

compare results. However, the qualitative assessment of this EIS provides for an objective comparison of the many studies and processes.

5.3.2 Natural Environment

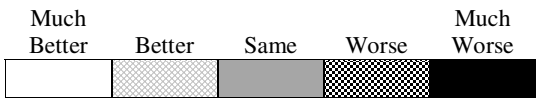
The Policy Direction ultimately selected and implemented will result in environmental effects on the natural environment. Effects on air quality, land, water, and fish and wildlife are evaluated for each Policy Direction. For water and fish and wildlife, the environmental effects are evaluated and described by subcategories. The anticipated effects associated with each Policy Direction are discussed throughout this section.

5.3.2.1 Air Quality

Table 5.3-1A displays how effects on air quality vary across the range of Policy Directions. Emissions of major concern are carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen (NO_X), particulate matter (PM_{10}), and sulfur dioxide (SO_2). Effects are shown, by shading, to indicate whether a given Policy Direction would tend to have effects on humans that are the same as, better than, or worse than Status Quo. Fewer air pollution emissions are characterized as better in the table. Most of the effects are based on information from the Columbia River SOR EIS, the Phase I Results of BPA's Regional Air Quality Modeling Study, and the Lower Snake River Juvenile Migration Feasibility Study EIS.[208]

Table 5.3-1A: Air Quality Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
CO						
CO_2						
NO_x						
PM_{10}						
SO_2						



[208] USDOE/BPA, Corps, and Bureau 1995c, Section 4.3; USDOE/BPA 2001d; and Corps 2002b, Section 5.3 Air Quality, Table 5.3-6 and Section 5.3.2.4 Alternative 4—Dam Breaching.

Summary of Effects: Under both Natural and Weak Stock Policy Directions, air emissions from most of the pollutants would be much worse than Status Quo largely due to the effects of dam breaching. However, PM_{10} would only be worse than Status Quo largely due to the exposed areas becoming revegetated. This would happen at a faster rate under Weak Stock as these areas are actively enhanced.

Under the Sustainable Use and Strong Stock Policy Directions air emission would be about the same as Status Quo. Although hydro operations are not further constrained under a Sustainable Use Focus, fish and wildlife restrictions still limit development. Under Strong Stock there would be fewer fish and wildlife restrictions and more power would be generated. However, development would also increase and new non-hydro power resources would be constructed to meet the demand.

The Commerce Focus increased air emissions would result from expanding economic activity and new power sources needed to support it. These effects are described in greater detail in Table 5.3-1B.

Table 5.3-1B: Air Quality Effects Across the Policy Directions Analysis

EFFECT AREA: AIR QUALITY (POLLUTION) fewer emissions = better	
Existing Conditions	Impacts on air emissions mainly result from transportation, construction activities, and energy generation. The air emissions of major concern are carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), particulate matter (PM_{10}), and sulfur dioxide (SO_2).[209] Barges, trains, and trucks remain the main modes of transportation for moving commodities within in the Region.[210] Trains, trucks, and ocean-going cargo vessels are used widely for importing and exporting goods to and from the Region. These modes of transportation mainly influence the levels of CO, CO_2, NO_x, and SO_2. Construction activities and the exposure of sediment can result in increased PM_{10}. The main fuel sources for power generation that affect air quality include primarily natural gas and coal, and to a lesser extent, wood residue.[211] These fuels can cause increases in CO, CO_2, NO_x, SO_2, and PM_{10}.
POLICY DIRECTION	
Status Quo	Between 1990 and 2000, based on the U.S. Census Bureau data, the Region (OR, WA, ID, MT) experienced about a 21% growth in population; it has a projected growth of about 19% between 2000 and 2015.[212] In 2001, regional firm power resources totaled about 21,000 aMW (based on a twelve-month average and 1936-37 water conditions). Of the 21,000 aMW, the major components were hydro, coal, imports, non-utility generation, nuclear, and combustion turbines.[213] Since 1995,

[209] Corps 2002b, Section 4.3.1.1 Regulated Air Pollutants; and USDOE/BPA 1995, Section 3.6.3 Air Quality.

[210] Council 2000, Section 5.3.4 Transportation.

[211] See Appendix E of this EIS.

[212] Data taken from US Census Bureau, http://www.census.gov/population/projections/state/stpjpop.txt (last visited February, 2003).

[213] See Chapter 5 of this EIS, Section 5.2.3.1. Air Quality.

EFFECT AREA: AIR QUALITY (POLLUTION) fewer emissions = better	
	hydrosystem operation (FCRPS) requirements for salmon recovery have reduced hydropower generation in the Region by about 1000 MW.[214] Relative to existing air conditions, the Status Quo Policy Direction is expected to include some increase in air pollutants associated with additional economic growth: the need for increased transportation of commodities and increased generating resources (mostly combustion turbines [CTs]).[215] The increase in air emissions will be regulated by existing pollution abatement programs, such as those under the Clean Air Act, and mitigated by technological improvements.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Drawdown of reservoirs and breaching of dams[216] cause impacts from emissions associated with thermal power plants used to replace lost hydropower, increased truck and train use to replace lost navigation, deconstruction-related emissions, and windblown dust from exposed dry sediments. This Policy Direction would require a sizable increase in power generation, most likely from new CTs, to replace hydropower lost from breaching and drawdown. For example, breaching the four lower Snake River dams and the John Day Dam to a "natural river" level would decrease generating capacity by about 2,000 aMW.[217] In addition, barge traffic would decrease considerably, leading to increased air emissions from the new truck and train traffic needed to replace lost barging capabilities.[218] Actual dam deconstruction would increase airborne particulate matter (PM_{10}); and, as reservoirs empty, dust would rise from newly exposed land. As new vegetation covered the land, dust would decrease, so these deconstruction and reservoir effects would be temporary.[219] Therefore, PM_{10} emissions would only be worse compared to Status Quo. Overall, however, there would be much more air emissions resulting in impacts much worse than compared to Status Quo.
Weak Stock Focus	Impacts from dam breaching would be similar to those for Natural Focus, except that the amount of increased air emissions would be somewhat less because fewer dams would be breached (although there might be an additional decrease in power from changes in hydro operation to benefit listed species). For example, over the next 10-20 years, removing the four lower Snake River dams would reduce BPA firm sales by about 800-1000 aMW.[220] Long-term air emissions would increase from increased

[214] See Chapter 2 of this EIS, Section 2.3.2.2. Other Federal Agencies and General Statutory Responsibilities.

[215] See Chapter 5 of this EIS, Section 5.2.3.1. Air Quality and Appendix E, Table B. Increased coal generation would increase CO, CO2, NOX, PM10, and SO2 emissions. Additional combustion turbine plants would produce the same pollutants as coal, but at a much lower rate per unit of energy produced because of greater efficiency (note: the reason SO2 is present is that it is used in natural gas as an odor indicator).

[216] The six dams to be breached would be the four Lower Snake River Dams, and the John Day and McNary Dams on the mainstem of the Columbia River.

[217] Corps 2000, Section 10.4.6.2 Social Effects by Area of Impact: Power; Corps 2002, Section 5.10.1.2 Power System Models.

[218] Data compiled in the Lower Snake River Juvenile Migration Feasibility Study FEIS suggest that NOX, PM10 emissions would increase; CO emissions would remain about the same; and SO2 emissions would decrease. Corps 2002b, Section 5.3 Air Quality, Table 5.3-4.

[219] Corps 2002b, Section 5.3.2.4 Alternative 4—Dam Breaching; Corps 2000, Section 7.6 Air Quality Impacts.

[220] Corps 2002b, Section 5.10.1.2 Power System Models.

EFFECT AREA: AIR QUALITY (POLLUTION) fewer emissions = better	
	truck and train traffic that would replace lost navigation capability.[221] Air emissions from deconstruction and reservoir drawdown would be measurable, but short-term as active revegetation practices are used. Overall, air pollution would be much worse in the long-term under this Policy Direction, compared to conditions under Status Quo.
Sustainable Use Focus	Modifying hydro operations are not expected to affect air emissions much, if at all, because of the negligible need for replacement power.[222] No change is expected from increased road and rail transportation to replace navigation. Air emissions is not likely to change compared to Status Quo.
Strong Stock Focus	Restrictions on hydro operations specific to weak-stocks would be removed if they do not adversely affect strong stocks. Costly weak-stock recovery modifications would not be implemented and hydropower production would not be curtailed. Therefore, there would be no need for replacement power. However, economic activity, no longer limited by weak-stock recovery efforts, would be allowed to increase. Consequently, the need for new generation would increase, and likely result in an increase in air emissions. The Clean Air Act would still limit increases in new air emissions. Overall, this Policy Direction would result in about the same amount of air emissions as Status Quo.
Commerce Focus	Because there would be fewer restrictions on hydrosystem for power production, generation would increase and there would be no immediate need for replacement power resources. Regional commercial competitiveness could attract new industry, increasing PM_{10} and CO_2 air emissions; such attraction would also increase the need for more power generation beyond what the hydrosystem could generate. In that case, new power sources would be constructed, which would increase air emissions, limited by the Clean Air Act. Overall, air emissions would be worse under this Policy Direction than under Status Quo.

5.3.2.2 Land Habitat

Table 5.3-2A shows how implementing the different Policy Directions would affect land habitat. Effect area subcategories include the following: quality and amount of upland habitat; and quality and amount of riparian/wetland habitat, including streamside, shoreline, and isolated wetland areas. Effects are shown, by shading, to indicate whether implementing a given Policy Direction would have effects on fish and wildlife and their habitats that are the same as, better than, or worse than Status Quo. More quality habitat is characterized as "better" in the table.

[221] Corps 2002b, Section 5.3.2.4 Alternative 4—Dam Breaching: Emissions Associated with Loss of Barge Transportation.

[222] Corps 2002b, Section 5.10.2.2 Alternative 2—Maximum Transport of Juvenile Salmon and Alternative 3—Major System Improvements; USDOE/BPA 2000d.

Table 5.3-2A: Land and Land Use Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Upland habitat: Quality						
Upland habitat: Amount						
Riparian/wetland habitat: Quality						
Riparian/wetland habitat: Amount						

Summary of Effects: Under Natural Focus and Weak Stock there would be more upland and riparian/wetland habitat than compared to Status Quo. Because active methods generally would not be taken to enhance habitat under Natural Focus, there would be no overall improvement of habitat gained through this Policy Direction. However, there would still be some quality habitat similar to the amount under Status Quo. Under Weak Stock, the active management approach would result in greater amounts of high quality habitat than compared to Status Quo.

The Sustainable Use Policy Direction would result in more quality upland and riparian/wetland habitat than compared to Status Quo. An active approach to enhance and manage more habitat than managed under Status Quo results in these gains.

Strong Stock Focus would maintain the upland, riparian, and wetland habitats that support healthy fish and wildlife resulting in about the same amount of upland and riparian/wetland habitats as under Status Quo. Overall, the quality of upland, riparian, and wetland habitat would be improved compared to Status Quo, because productive areas are maintained and enhanced.

Commerce Focus would ease restrictions and encourage more development, especially in uplands. Compared to Status Quo, the Commerce Focus Policy Direction would result in similar quality habitat. Although there would be about the same amount of riparian/wetland habitat as Status Quo, there would be less upland habitat.

These effects are described in greater detail in Table 5.3-2B.

Table 5.3-2B: Land and Land Use Effects Across the Policy Directions Analysis

EFFECT AREA: LAND HABITAT more quality habitat = better	
Existing Conditions	With regard to fish and wildlife, the most important land and land use issues concern the potential loss of and adverse impacts on habitat from human activities. The overall quality of upland habitat has decreased because of such activities as overgrazing, timber harvest, introduction of exotic species, and inundation by dam construction. The overall extent and continuity of riparian areas has decreased, primarily because of conversion to agriculture and range, but also because of urbanization, transportation improvements, and stream-channel modifications.[223] Quality riparian shrublands have also been lost because of excessive livestock grazing and increases in exotic vegetation.[224] Overall, wetlands have decreased because land use activities have degraded, modified, or destroyed them. However, creation of water impoundments has allowed for some limited increases in wetland habitat. As a result of the creation of the impoundments, wetland habitat has increased from roughly 10 to more than 300 acres in the lower Snake River area, while riparian habitat has decreased by almost 1,500 acres. As a result of construction of the John Day dam, wetland habitat has increased from about 1,600 to almost 2,300 acres,[225] while riparian habitat has decreased by almost 1,600 acres.[226] However, there is a documented loss of more than 12,000 acres of upland habitat when the impoundments were created for the lower Snake dams.[227] The use or development of some habitat areas is controlled or limited by natural resources regulations.
POLICY DIRECTION	
Status Quo	Habitat fragmentation has increased, especially in upland and riparian areas in the Basin.[228] Mitigation efforts have focused on protecting, enhancing, and managing land habitat, but there continues to be a legacy of habitat fragmentation. Development of native habitat and agricultural land will increase to meet the demand for urban growth and other land use activities. For example, in 1998, Oregon's Metropolitan Service District (Metro) expanded the Portland area's urban growth boundary by 3,527 acres to meet future needs (providing 14,000 jobs and room for roughly 23,000 housing units). In 1999, the Metro Council voted to include another 377 acres.[229] Similar increases are occurring in other Oregon municipalities. Overall, valuable upland habitat has decreased. However, upland habitat quality has increased in some areas, where it had been historically degraded (e.g., overgrazed) and is currently being restored.[230] Some of these increases are marred by the invasion of exotic species and other changes in landscape composition. Wetland habitat has increased in some areas and decreased in others, while overall riparian

[223] USDA/USFS and USDOI/BLM 2000b, Chapter 2 Affected Environment, Terrestrial Species.

[224] USDA/USFS and USDOI/BLM 2000b, Chapter 2 Affected Environment, Terrestrial Species.

[225] Corps 2002b, Section 4.6.1 Vegetation, Table 4.6-1; Corps 2000, Section 8.1 Mitigation Measures for Wildlife Resources, Table 50.

[226] Corps 2002b, Section 4.6.1 Vegetation, Table 4.6-1; Corps 2000, Section 8.1 Mitigation Measures for Wildlife Resources, Table 50.

[227] Corps 2002b, Section 4.6.1 Vegetation, Table 4.6-1.

[228] Corps 2002b, Section 4.6.1 Vegetation, Table 4.6-1.

[229] Metro 2003.

[230] Corps 2002b, Section 4.6 Terrestrial Resources.

EFFECT AREA: LAND HABITAT more quality habitat = better	
	habitat has decreased and become fragmented. However, some replacement riparian habitat has been created. Mitigation efforts have focused on managing habitat, but there continues to be a trend toward increased habitat fragmentation.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Breaching or modifying the six dams would result in an increase in the amount of upland and riparian habitat, but it could result in a decrease in wetland habitat in certain areas. Dam breaching would expose more than 39,000 acres of inundated land.[231] Terrestrial/ riparian restoration efforts would focus on preserving land and stopping land-use activities by humans such as farming, grazing, mining, other development, and access in certain protected areas. Restoration emphasizes passive techniques, resulting in the natural succession of fish and wildlife habitat. No effort would be placed on the control of exotic plant species (e.g., cheatgrass, knapweed, and yellow star-thistle) that can alter habitat quality, sometimes by forming monocultures that restrict wildlife use and reduce species diversity (e.g., knapweed limits elk browsing opportunities).[232] Periodic natural disturbance, such as flooding and fire, would be part of the natural restoration process. Overall, there would be much more upland and riparian/wetland habitat, but the quality of these habitat types would be about the same as under Status Quo.
Weak Stock Focus	Substantial human intervention to enhance lost or degraded habitat would benefit ESA-listed fish and wildlife, especially in areas designated as critical habitat. Dam breaching or modification would create some upland and riparian habitat. Breaching of the four lower Snake River Dams would expose about 14,000 acres of previously inundated land.[233] Active habitat improvements would be used primarily to obtain important habitat features for listed species, and control non-native vegetation. Land use activities that affect listed species would be curtailed. A variety of habitat protection and enhancement mechanisms would be used, such as purchase of conservation easements, fee title acquisitions, riparian fencing, and cost-sharing with other Federal agencies under various agricultural incentive programs. Habitat protection and enhancement efforts would be conducted using a "watershed" or "ecosystem" approach, i.e., a more comprehensive look at a sub-basin and its biological needs. Habitat restoration and enhancement efforts would result in an increase in high-quality habitat for listed species. Overall, there would be much more upland and riparian/wetland habitat and the quality of these habitat types would be better than under Status Quo.
Sustainable Use Focus	A management approach that considers habitat needs for both listed and non-listed fish and wildlife would be used. Habitat conservation would be strengthened through improved management of agriculture, forestry, livestock grazing, mining, and road building. There would be an intensive effort to manage habitat, and a moderate effort to rebuild it. The focus would be on multi-species conservation and active management of their habitats. Active management methods might include more land shaping, removal of migration obstructions, exotic species control, and riparian/wetland enhancement. These actions would result in conserving some areas that would be developed under Status Quo. Overall, there would be more quality

[231] Corps 2000, Section 7.18.1 Wildlife Habitats, Table 44; Corps 2002b, Section 5.2.3 Alternative 4—Dam Breaching (the 39,000 acres only includes the four Lower Snake dams and the John Day dam; because McNary Dam is not included in the total, the result would be higher).

[232] Sheley, R.L. et al. 1998.

[233] Corps 2002b, at Section 5.2.3 Alternative 4—Dam Breaching.

EFFECT AREA: LAND HABITAT more quality habitat = better	
	upland and riparian/wetland habitat than under Status Quo.
Strong Stock Focus	Management actions would focus on maintaining existing habitat for healthy populations of fish and wildlife. Strong Stock habitat would not be sacrificed for weak stocks, but improved where most stocks would benefit. An emphasis would be placed on the maintenance and active management of habitat to prevent further degradation. Priority would be given to existing habitat that supports strong and healthy populations of fish and wildlife to ensure continued productivity. Efforts would result in higher quality habitat than under Status Quo, however the amount of upland and riparian/wetland habitat would be about the same as under Status Quo.
Commerce Focus	Land would not be improved or maintained for habitat unless the benefit of such management was to exceed the costs. Federal, regional and state programs for habitat enhancement would be limited and focused on the land most valuable for species and less valuable for commercial interests. However, areas suitable for both habitat rebuilding and increased recreational opportunities would be managed for those multiple uses. Some existing terrestrial habitat would be developed for commercial interests. Voluntary actions and financial incentives would be used to implement private, cost-effective, and efficient habitat enhancement and maintenance. Mitigation concepts such as mitigation credit trading would be used to provide replacement habitat or preserve other habitat as a credit against new development. Financial incentives, such as start-up grants, tax breaks, and technical assistance, would be used to encourage local landowners, businesses, corporations, and trustee agencies to improve wetland, riparian, and terrestrial areas. Overall, there would likely be less upland habitat than under Status Quo, but riparian/wetland habitat would be about the same. Habitat quality for both upland and riparian/wetlands would be about the same as Status Quo.

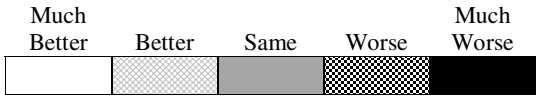
5.3.2.3 Water Habitat

Table 5.3-3A shows how the Policy Directions would affect water quality, instream water quantity, and the amount of river and reservoir habitat for fish and wildlife. Effects are shown, by shading, to indicate whether a given Policy Direction would tend to have effects that are the same as, better than, or worse than Status Quo. Improving aquatic conditions for fish and wildlife is characterized as "better" in the table. Some increases in water quality factors, such as more instream water quantity and amount of habitat, would be better for most fish and wildlife, but other increases, such as more nitrogen supersaturation or sedimentation, would be worse.

Table 5.3-3A: Water Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Nitrogen Supersaturation						
Non-thermal Pollution						
Sedimentation						

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Temperature/ Dissolved Oxygen						
Instream Water Quantity						
Amount of Stream/River Habitat						
Reservoir Habitat						



Summary of Effects: Breaching six dams under the Natural Focus Policy Direction would result in more river-like conditions in those stretches of the Columbia and Snake Rivers. This Direction would result in long term improvements in all water quality factors. In fact, several factors would be much better than Status Quo. There would also be gain in the amount of instream water and stream/river habitat. However, because six dams are breached there would be much less reservoir habitat available compared to Status Quo.

The Weak Stock Policy would have similar effects as those described for Natural Focus, however, some water quality improvements would not be as great. Also, since only four dams are breached, the amount of reservoir habitat would only be worse than compared to Status Quo.

Under Sustainable Use there would be some improvements in water quality. However, nitrogen supersaturation and temperature/DO would remain the same as Status Quo. This would be largely due to hydrosystem operations designed to benefit fish and wildlife. There would also be improvements in the amount of instream water and river/stream habitat because of active water acquisitions and habitat enhancements. Since no dams would be breached under this Direction, the amount of reservoir habitat would be the same as under Status Quo.

Strong Stock Focus would result in improvements in nitrogen supersaturation, as spill is reduced. However, there would be increases in sedimentation as more development is allowed. Other water quality parameters would be the same as Status Quo. The amounts of instream water and river/stream habitat would also be the same as under Status Quo. However, there would be more reservoir habitat as reservoir levels are maintained.

Commerce Focus would result in improvements in nitrogen supersaturation, as spill is reduced, however other water quality parameters would be worse due to increasing

development. The amount of instream water and river/stream habitat would also be worse as development is given priority. Reservoir habitat would likely increase as reservoirs are used for increased storage compared to Status Quo.

These effects are described in greater detail in Table 5.3-3B.

Table 5.3-3B: Water Effects Across the Policy Directions Analysis

EFFECT AREA: WATER HABITAT: Nitrogen Supersaturation less = better	
Existing Conditions	The main issue for fish concerning nitrogen supersaturation is increased mortality because of gas bubble trauma (GBT), a condition caused by high levels of dissolved gas. Nitrogen supersaturation, also referred to as Total Dissolved Gas (TDG), is caused by water spilling over large dams. As spill volumes increase, the dissolved gas concentrations downstream consistently increase. As the river flow passes each of the lower Snake and Columbia River dams, sequential spill causes the concentration of dissolved gas in the river to increase, incrementally and cumulatively. Many existing structures were not designed to minimize nitrogen supersaturation problems when they were constructed. For Washington, Idaho, and Oregon, a TDG standard of 110% saturation at ambient atmospheric pressure is the maximum concentration for TDG. However, the Washington Department of Ecology (WDOE) has waived the state standard for the four lower Snake River dams; WDOE has set an upper limit of 115% saturation in the forebays and 120% saturation in the tailwater. If the measured concentrations exceed these values (based on a daily average of the 12 highest hourly measurements), then the spill release is curtailed to meet the limits. The lower Snake River between the Clearwater River and Columbia River has been placed on the Washington 303(d) list as water-quality-impaired for dissolved gas.[234] Segments of the Columbia River in Oregon are also listed; Oregon is considering similar action.
POLICY DIRECTION	
Status Quo	TDG is being managed by controlled flow, voluntary spillway releases, installation of flow deflectors, and other spillway modifications. Some excessive voluntary spill operations for weak stocks and spring migrations may continue to cause TDG problems. Unless turbines and generators are fully modernized, failure of the units would cause substantial TDG effects, as happened at Ice Harbor in 1995-1996. Attempts to manage spill at dams to keep gas levels within Federal CWA guidelines would be partially attainable, except in high flow years. Additional spillway flow deflectors, modifications to existing spillway flow deflectors, and pier wall extensions would be added to further reduce dissolved gas concentrations and, thus, provide more control of TDG levels. Overall, the dissolved gas abatement structures should help lower TDG concentrations.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The breaching of six dams would eliminate the TDG problems from those specific sites. However, as plunge pools form during the development of a stable channel morphology under a different flow regime, geographically localized TDG above 110% is possible infrequently and for short durations.[235] The closer the return to a natural river, the less TDG supersaturation would remain a problem. Those dams that

[234] Corps 2002b, Section 4.4.2.2 Water Quality Parameters and Standards.

[235] Corps 2002b, Section 5.4.2.4 Total Dissolved Gas.

EFFECT AREA: WATER HABITAT: Nitrogen Supersaturation less = better	
	remained could experience elevated TDG locally, as a result of an increase in flow and the need to spill additional water. Removing six dams would reduce the cumulative effect of TDG. Overall, there would be a very large decrease in TDG, compared to conditions under Status Quo.
Weak Stock Focus	Removing four dams would eliminate TDG problems from those specific sites, with effects similar to those under Natural Focus. Therefore, these actions could also decrease the cumulative TDG effect of the entire hydro system, although there could be local fluctuations. If other dam operations increased flows for weak stocks, they would increase the levels of saturated gas exposure mainly through increased spill. Existing dams would be further modified to reduce TDG, benefiting weak stocks. Overall, there would be a large decrease in TDG, compared to conditions under Status Quo.
Sustainable Use Focus	Spill and flow regimes would be balanced with state CWA standards. Structural improvements would be made to the dams to benefit fish and wildlife. Improvements could include new spillway flow deflectors, modifications to existing spillway flow deflectors, and pier wall extensions. Overall, however, TDG supersaturation, a problem even with improvements, would be the same as Status Quo.
Strong Stock Focus	Healthy, strong stocks would be less dependent on coordinated spill and flow schemes, and juvenile transportation would be used more to further reduce spill. The reduction in spill would decrease the amount of supersaturated gas in the river. Overall, there would likely be a decrease in the TDG problems compared to Status Quo.
Commerce Focus	Except in instances of flood control releases or large flows, spill would be minimized under a commercial focus. The water normally spilled would likely be stored for a higher commercial value, such as power production or municipal use. If spill for fish were unable to achieve some kind of commercial benefit, it would likely be discontinued, resulting in a reduction in TDG. Overall, TDG levels would be less than under Status Quo.

EFFECT AREA: WATER HABITAT: Non-thermal pollution less = better	
Existing Conditions	The main concerns for fish and wildlife regarding non-thermal pollution include direct adverse physiological effects (e.g., bioaccumulation, direct contact) and habitat degradation. Non-thermal pollution can include excesses of organic matter, fertilizers (e.g., phosphates), pesticides (e.g., DDT, aldrin, heptachlor), herbicides (e.g., 2,4-D), sediment (sedimentation is discussed separately below), acid mine drainage, and a large number of metals (e.g., arsenic, lead, mercury) and chemicals (e.g., dioxins). Sources of non-thermal pollution include municipal and industrial wastewater, industrial facilities, irrigation return flows, mine runoff, agricultural and grazing runoff, and untreated storm water. Agriculture represents the largest nonpoint source of non-thermal pollution and uses the largest amount of surface water within the Basin.[236] There are 7 to 9 million acres of irrigated land in the Columbia River Basin used for both agriculture and grazing. The discharge of point source pollution is regulated by either EPA, or authorized state agencies, through NPDES permits under the CWA. Water quality is also regulated by state-specific water quality standards. Increases in non-thermal pollution can result in changes to

[236] NMFS 2000b, Section 5.3.2 Habitat Effects.

EFFECT AREA: WATER HABITAT: Non-thermal pollution less = better	
	the pH levels. The discharge of non-thermal pollution can impair water quality and designated beneficial uses of specific bodies of water.
POLICY DIRECTION	
Status Quo	Between 1990 and 2000, based on U.S. Census Bureau data, the Region experienced about a 21% growth in population; it has a projected growth of about 19% between 2000 and 2015.[237] Increasing population and economic growth produces additional pollution, but existing and planned regulations and programs, technological improvements driving new industries and the decline of old, less-regulated industries all combine to reduce pollution. The net effect is that pollution would increase from existing levels. Non-thermal pollution would continue to be regulated under the CWA and new water quality standards that limit the Total Maximum Daily Loads (TMDLs) of pollutants.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Non-thermal pollution would likely decrease as habitat is protected and access is limited to these areas, thereby decreasing the sources of pollution. The drawdown and removal of six dams could result in limited increases in non-thermal pollution as previously settled contaminates are re-released into the water column; however, there would be a long-term net benefit. (See Sedimentation, below.) Discharges of non-thermal pollution would be reduced through new controls on wastewater and other point and non-point sources to meet more stringent state water quality criteria pursuant to the CWA. Stronger enforcement of discharge permits would help ensure that water quality standards are met. Overall, the level of non-thermal pollution would be less than that under Status Quo.
Weak Stock Focus	Improvements in water quality may be achieved by actively pursuing reductions in non-thermal pollution to meet water quality criteria for listed anadromous and resident fish. New controls on wastewater and other point and non-point sources to meet more stringent state water quality criteria pursuant to the CWA would reduce discharges of non-thermal pollution. Increased enforcement of water quality standards for pollutants would be focused in the critical habitat of listed species. Efforts would be made in agricultural management and residential/commercial development to reduce non-point sources in targeted weak-stock tributaries. Non-thermal pollution would be further reduced by efforts to enhance more habitat for listed fish and wildlife. The drawdown and removal of four dams could result in a short-term increase in non-thermal contaminants in association with sediment movement; however, these pollution levels would likely decrease in the long term.[238] Overall, there would be less non-thermal pollution compared to Status Quo.
Sustainable Use Focus	State and Federal water quality standards would be achieved and enforced throughout the Region pursuant to the CWA. Management for multiple purposes would include reductions in non-thermal pollution to improve water quality. Riparian land acquisition and active restoration would reduce upgradient non-point source contributions. Non-thermal pollution would be further reduced by efforts to improve other habitat to maintain harvestable populations of fish and wildlife. Positive incentives, monitoring, and enforcement would be used to reduce point and

[237] Data taken from US Census Bureau, http://www.census.gov/population/projections/state/stpjpop.txt (last visited February, 2003).

[238] Corps 2002b, Section 5.5.1.4 Alternative 4—Dam Breaching.

EFFECT AREA: WATER HABITAT: Non-thermal pollution less = better	
	non-point source pollution. Overall, there would be less non-thermal pollution compared to Status Quo.
Strong Stock Focus	Management of water quality throughout the Region would be targeted in habitat that would benefit healthy populations of fish and wildlife. Implementation of pollution controls would be prioritized to areas occupied by strong stocks. Increases in non-thermal pollution would continue to be regulated under the CWA and new water quality standards that limit the TMDL of particular pollutants. However, other areas would still be required to meet water quality standards. Overall, there would be about the same amount of non-thermal pollution as under the Status Quo.
Commerce Focus	Water quality would be managed to ensure health and safety of humans and continued provision of designated beneficial uses. There could be some use of positive incentives and trading of pollution credits allowed to accommodate industrial growth. Pollution controls would be efficient and cost-effective. Pollution levels might increase as a result of greater development. Overall, non-thermal pollution would be worse than compared to Status Quo.

EFFECT AREA: WATER HABITAT: Sedimentation less = better	
Existing Conditions	With respect to fish and wildlife, the main concern regarding sedimentation involves the potential degradation of aquatic habitat and the related adverse effects of soil erosion on terrestrial habitat. Sedimentation is the result of soil erosion, and is measured in terms of turbidity and suspended sediment. Turbidity is the amount of light scattered or absorbed by the water. Suspended sediment is the portion of the sediment load that moves suspended in the water column.[239] Accelerated sedimentation from erosion results from land disturbances, including agriculture, grazing, logging, and urban development, as well as channel dredging for river navigation. Landslides of various types occurring along reservoir shorelines also contribute to reservoir sedimentation.[240] Dams impound water and reduce velocity, allowing most suspended material to settle to the bottom of the reservoir and the rest to remain suspended in the water column. This action affects turbidity levels and the concentrations of contaminants— most are attached to sediment particles— in the reservoir. Sediment transport downstream of dams is affected because natural sediment movement is interrupted by the dams. Dredging to maintain navigation channels can increase the velocity of the current and the movement of suspended sediments; dredging can also disturb sediments that could contain toxic substances that are harmful to plants and animals.[241] Agricultural runoff contributes to sedimentation in some tributaries because return flows are often high in sediments. Historic forest practices contribute to stream sedimentation at existing roads and stream crossings, and to mass wasting. In addition there are direct effects on species. Although some level of sediment may be important to certain life stages of specific fish, too much sedimentation can reduce the survival of eggs and alevins, reduce primary and secondary productivity, interfere with feeding, and cause behavioral avoidance and breakdown of fish social organizations.[242]

[239] Corps 2002b, Section 4.4.2.2 Water Quality Parameters and Standards

[240] Corps 2002b, Section 4.2.4 Erosion and Sedimentation.

[241] Corps 2002b, Section 4.4.2.1 Activities in the Lower Snake River Affecting Water Quality.

[242] See Section 5.2.2.2 Water, in this EIS.

EFFECT AREA: WATER HABITAT: Sedimentation less = better	
POLICY DIRECTION	
Status Quo	Large sediment loads are deposited into the river system throughout the Basin. For example, the lower Snake River downstream of Lewiston, Idaho, annually transports approximately 3-4 million cubic yards of new sediments that have been eroded from its drainage basin. Approximately 100-150 million cubic yards of sediment have been deposited upstream of the four lower Snake River dams since Ice Harbor became operational in the early 1960s.[243] Although an increase in development may result in more sedimentation, other changes in land-use practices (conversion to more permanent crops, agricultural and grazing management, and practices to control erosion during construction) could compensate. The Region could experience gradual improvement as water quality standards, Best Management Practices (BMPs,) and new TMDLs are applied across the land base.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam breaching would allow the annual sediment accumulating behind the individual the six dams to be flushed downstream. Sediments would increase downstream from breached facilities as accumulated reservoir sediments flush downstream for more than 5-10 years. Removing the six dams under would result in most of the suspended sediment being deposited at or upstream from The Dalles Dam. The finer sediment (e.g., clays and silt) could travel past The Dalles and Bonneville Dams, to be deposited in either the Columbia River Estuary or the Pacific Ocean. The sediment would also cover large amounts of benthic habitat, disrupting primary productivity and food supplies in the short term. There would be adverse effects on anadromous stocks destined for the upper Columbia and Snake Rivers in the short term Erosion would increase from newly exposed land that had previously been submerged by reservoirs. Lowering the water levels by breaching the dams would expose mudflats and steep banks that are susceptible to sloughing and erosion during storm flow events. It is estimated that dam breaching could result in 68 potential failure areas on the 140-mile lower Snake River reach alone. It is anticipated that there could be at least two large failures on the Little Goose and Lower Granite reservoirs, and one large failure on the Ice Harbor and Lower Monumental reservoirs.[244] These effects would be temporary, until these areas could be stabilized. The retirement and protection of agricultural and other eroding lands, and a reduction in human uses, would reduce sediment loads over the long term relative to Status Quo. Overall, in the long-term there would be much less sedimentation than compared to Status Quo.
Weak Stock Focus	The effects would be similar to those under Natural Focus, but because fewer dams are breached, the duration and location of the short-term effects would be less. Short-term sediment loads would increase, but long-term loads would decrease to more natural rates in specific weak-stock tributaries through active management. The breaching of four dams would allow sediment that accumulates behind the individual dams to be carried downstream. For example, most of the incoming sediment would probably be deposited behind the McNary Dam. The finer sediment (e.g., clays and silt) would likely travel past McNary and be deposited in either the

[243] Corps 2002b, Section 4.2.4 Erosion and Sedimentation.

[244] Corps 2002b, Appendix D, Natural River Drawdown Engineering.

EFFECT AREA: WATER HABITAT: Sedimentation less = better	
	Columbia River estuary or the Pacific Ocean. Overall, there would be less sedimentation than compared to Status Quo.
Sustainable Use Focus	Erosion and sedimentation would be reduced throughout the Basin, as part of a more active land use management strategy. Enhancing and managing habitat (e.g., spawning gravel, soil conservation, streambank stabilization, and riparian management) might have temporary, adverse effects, but would result in the stabilizing of ground surfaces, decreasing sedimentation. Overall, sedimentation would be less compared to Status Quo.
Strong Stock Focus	Management for strong stocks would result in decreased flow and spill, and would focus on maintaining existing strong stock habitat, keeping it from further degradation. Commercial activity and development in other areas could increase, resulting in more erosion and deposits of sediment into the rivers. Because this development would be limited to areas not supporting strong stocks, the amount of sedimentation in those areas would remain about the same as compared to Status Quo. However, overall there would be more sedimentation than compared to Status Quo.
Commerce Focus	Sedimentation would increase as development increases. Although all new development would be required to comply with water quality standards, sediment controls must be efficient (benefits exceed costs) in order to be implemented. Incentives-based implementation actions would be used to focus water quality improvements in prime watersheds. Overall, sedimentation would be worse than under Status Quo.

EFFECT AREA: WATER HABITAT: Temperature/Dissolved Oxygen lower temperature = better	
Existing Conditions	Stressful water temperatures and low dissolved oxygen (DO) levels are major concerns for fish and wildlife. In the Columbia River, the major effect of dams on water temperature is to delay the occurrence of downstream maximum temperatures in late summer and to delay cooling in early autumn because of detained flows.[245] The capacity of water to hold oxygen in solution is inversely proportional to temperature. That is, higher stream temperatures result in lower concentrations of DO. Adequate DO concentrations are important for supporting fish, invertebrates, and other aquatic life. Increases in DO concentration can come from wind-created wave action, photosysnthesis, and the reaeration of water at the surface from spill. The potential for oxygen depletion is higher in slow, deep, biologically productive reservoirs. Water temperature is one of the critical parameters affecting adult and juvenile salmonid migration behavior during April through September. High water temperatures can stress salmon physiologically and become lethal, or trigger premature egg hatching. Salmonid mortality occurs at sustained temperatures of greater than 73°F. Low water temperatures can also cause cessation of spawning, increased egg mortalities, and susceptibility to disease.[246] Mainstem changes in temperature and DO levels are associated with dry years, low flows, long retention times, and warm weather. Thermal pollution from industrial discharges could also contribute to negative impacts. Tributary problems could be more closely linked to the timing and quantity of irrigation diversions, low storage releases, altered channel

[245] Corps 2000, at Section 4.8 Water Quality.

[246] See: Corps 1991; Federal Caucus 1999b and 2000b, Habitat Appendix, p. 134 and Hydro Appendix, p. 39; see Section 5.2.2.2 Water of this EIS.

EFFECT AREA: WATER HABITAT: Temperature/Dissolved Oxygen lower temperature = better	
	morphometry, increased solar radiation through loss of riparian and stream bank shading, and irrigation return flows. Hundreds of water bodies are identified as being impaired for these parameters.
POLICY DIRECTION	
Status Quo	Cooler water from the Dworshak reservoir is released during the summer months for temperature control, generally lowering temperatures 1.8-5.4°F in the Clearwater River and the Lower Granite reservoir, with diminishing benefits downstream on the Snake River. The State of Washington's water quality standards specify that water temperatures in the lower Snake River shall not exceed 68°F as a result of human activity. Oregon also disallows water temperature increases in the Columbia River, outside assigned mixing zones, when the stream water temperature is at or above 68°F. Idaho's specific temperature criterion for salmonid spawning calls for a maximum instantaneous water temperature in the mainstem Snake River of 72°F, with daily averages no greater than 66°F. In Washington, DO concentrations for Class A water must be equal to or greater than 8 milligrams per liter (mg/L) throughout the year. Oregon specifies at least 90% saturation for its portions of the Columbia River. Idaho requires the following minimum limits: at least 6 mg/L (30-day mean); 4.7 mg/L (7-day mean); 3.5 mg/L (instantaneous minimum); and 6 mg/L or 90% of saturation (whichever is greater) for salmonid spawning purposes.[247] Revised regional water quality standards and TMDLs for impaired watersheds should bring about gradual improvement. Water temperature/DO conditions could be affected by global warming.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	A return to a natural river and natural tributaries, dam breaching, land retirement, and strong thermal pollution controls could gradually help improve water temperature, including normal fluctuations for the rivers affected. However, water temperatures during low-flow years could reach higher summer peaks under the near-natural river conditions than under the existing impounded river conditions.[248] Under wet and average conditions, peak summer temperatures are projected to be similar to those observed under existing conditions.[249] Upstream reservoirs (upper Columbia, upper Snake, Clearwater) would have to be managed for flow in dry years to avoid downstream problems. These temperature fluctuations would have an inverse effect on DO. However, an increase in nutrients related to erosion could cause short-term, harmful reductions in DO in slack waters.[250] There would be less opportunity for solar heating because of reduced water surface area. However, because some of the reservoirs are operated as run-of-river, usually with relatively short water retention times, the change in temperature would be minimal.[251] There would be fewer opportunities to control temperature through controlled releases. Although conditions could be worse or not improved in very dry years, overall both temperature and DO would be somewhat better than under Status Quo.

[247] Corps 2002b, Appendix C, Section 3.2.2 Water Quality Standards, Table 3-1.

[248] Corps 2002b, Section 5.4.2.2 Water Temperature.

[249] Corps 2002b, Section 5.4.2.2 Water Temperature.

[250] Corps 2000, Section 7.5.7 Dissolved Oxygen.

[251] Corps 2000, Section 7.5.3 Temperature.

EFFECT AREA: WATER HABITAT: Temperature/Dissolved Oxygen lower temperature = better	
Weak Stock Focus	This Policy Direction would be similar to Natural Focus but would entail less dam breaching, more aggressive management measures focused in weak-stock areas, and more management of irrigation (as opposed to land retirement). Further modifications and limitations to the hydrosystem could result in more cold-water releases to benefit listed species, especially in very dry or hot years. Gains could be greatest where weak stocks are found in water-quality-impaired waters. Overall, temperature and DO would be better than under Status Quo.
Sustainable Use Focus	Efforts would focus on reducing water temperatures in many tributaries. These actions could include systemwide irrigation water management, retention and reuse of irrigation return flows, and active streambed and riparian management to increase shading along strategic reaches. However, reducing water temperature in tributaries would have little effect on the mainstem. Temperature control structures, improved mixing zones, and cold-water releases on mainstem and upstream tributary facilities might also help. Overall, temperature and DO would likely be about the same as under Status Quo.
Strong Stock Focus	Standards for temperature and dissolved oxygen would be met. Additional efforts such as techniques to cool water or manage dissolved oxygen would be implemented only if needed to benefit healthy stocks. Water temperatures and DO levels would be about the same as those under Status Quo.
Commerce Focus	Thermal pollution would be managed primarily to ensure human health and safety. Any temperature or DO control must be cost-effective; and most controls would be driven by regulation. Temperature in a particular watershed might improve, especially if it is determined that a cold-water fishery is a valuable use of the watershed. Overall, temperatures and DO would be worse than under Status Quo.

EFFECT AREA: WATER HABITAT: Instream Water Quantity more = better	
Existing Conditions	With respect to fish and wildlife, the main concern regarding instream water quantity is the loss of habitat caused by water withdrawals during summer months, when water levels are at their lowest. Water withdrawals from the system, including those for consumption, storage, irrigation, and groundwater storage, reduce the amounts of river and stream water and flows. Tributaries, arid areas, and areas upstream of the four lower Snake River dams experience the most substantial adverse effects from water withdrawals. Also, urban watersheds with large areas of impervious surfaces exhibit altered streamflows.
POLICY DIRECTION	
Status Quo	Water quantity problems are a major cause of habitat degradation and reduced fish production. Withdrawing water for irrigation and for urban and other uses, can increase temperatures, smolt travel time, and sedimentation. Withdrawals affect seasonal flow patterns by removing water from streams in the summer (mostly May through September). Water returns to surface streams and groundwater in ways that are difficult to measure. For example, average mean daily flows are at minimum from mid-summer (mid-July) to the early fall (mid-October), while average mean daily flows are at maximum from mid-May to mid-June (where streams are affected by snow runoff).[252] Programs to manage storage releases (e.g., flow augmentation

[252] Corps 2002b, Section 4.4.1 Hydrology.

EFFECT AREA: WATER HABITAT: Instream Water Quantity more = better	
	and spill) and acquire water rights/leases from irrigation (e.g., the 427,000 acre-feet (AF) to augment Snake River flows) would continue. Development of new surface-water irrigation is limited by state law and prior appropriations. Water conservation programs to increase efficient use of water (such as irrigation management, more efficient irrigation systems, and monitoring systems) would reduce per-acre water application.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam breaching would greatly reduce the flow and surface area of the affected rivers and cause different seasonal fluctuations in flow. Instream water quantity would also fluctuate similarly to natural conditions in breached sections. This latter result could have both positive and negative effects for fish, based on such factors as water year and migration timing. Increased flows from drawdown could decrease the river travel time for migrating fish.[253] The quantity and flow would still be limited by irrigation and domestic withdrawals. The preservation and protection of land could increase water quantity, as long as the lands that were preserved had water rights that were designated for instream use. Also, the cost of reconfiguring affected irrigation systems and the loss of pumping stations could deter some farmers, further reducing irrigation withdrawal. In low flow periods, water quantity would likely be slightly worse than Status Quo. However, overall, there would be more instream water than compared to Status Quo.
Weak Stock Focus	Dam breaching would greatly reduce the quantity and surface area of the affected river. For example, as a result of breaching four dams, the surface area of the Snake River would be reduced from about 33,000 acres to 19,000 acres. Flow depths and water quantity would vary seasonally.[254] This variation could have both positive and negative effects for fish, based on such factors as water year and migration timing. Increased flows due to drawdown could decrease the travel time for migrating fish.[255] Irrigation and industrial withdrawals would be reduced where there would be direct effects on weak stocks; land retirement or interbasin transfers of water would be emphasized. Storage would be managed to increase instream flow for weak stocks. Most increases in water quantity would be in the Snake River system and in arid tributary regions in Central/Eastern Oregon and Washington. Overall, instream water quantity would be better than under Status Quo.
Sustainable Use Focus	The amount of water withdrawn would be reduced, primarily by using more efficient technology and water conservation programs. Water rights acquired from irrigated lands in riparian zones would be used to leave water in streams to benefit fish and wildlife. Irrigation and other withdrawals would be managed to reduce or avoid adverse effects. Some storage would be used to increase flows during fish migrations. Overall, there would be more instream water than Status Quo.
Strong Stock Focus	Water withdrawals would be managed to avoid future ESA listing of strong stocks. Actions would be taken to maintain or enhance existing instream water quantities in areas important for strong stocks. Increased commercial activity and population growth would require more water; however, withdrawals would be limited in areas affecting strong stocks. Efforts to augment instream water would increase in dry years. Overall, instream water quantities would be about the same as those under Status Quo.

[253] Corps 2000, Section 7.17.1.4 Rate of Migration.

[254] Corps 2002b, Section 5.4.1.3 Alternative 4—Dam Breaching.

[255] Corps 2000, Section 7.17.1.4 Rate of Migration.

EFFECT AREA: WATER HABITAT: Instream Water Quantity more = better	
Commerce Focus	Irrigation, industrial, and municipal water withdrawals would increase to meet demand. New rights would be issued for water withdrawals, but incentives for cost-effective and efficient conservation efforts might be used to avoid direct mortality of listed stocks. Most water conservation efforts would be limited to those that are economically viable. Fish and wildlife actions would attempt to reduce impacts through projects such as aquifer storage and recovery, which can sequence withdrawals to particular periods resulting in fewer effects. Overall, instream water quantity would decrease compared to conditions under Status Quo.

EFFECT AREA: WATER HABITAT: Amount of Stream/River Habitat more = better	
Existing Conditions	The amount of stream/river habitat, a function of instream water quantity, is a major concern for fish and wildlife management efforts. The quality and quantity of freshwater habitat in much of the Columbia River Basin have declined dramatically in the last 150 years. Activities such as logging, farming, grazing, road construction, mining, and urbanization have changed the historical habitat conditions of the Basin.[256] By creating passage obstructions, these activities can make suitable habitat inaccessible. The amount of stream and river habitat is also related to the highly regulated nature of the river system. Mainstem habitats of the Columbia, Snake, and Willamette rivers have been affected by impoundments that have inundated large amounts of spawning and rearing habitat, reducing that habitat, for the most part, to a single channel. Floodplains have also been reduced in size, off-channel habitat features have been lost or disconnected from the main channel, and the amount of large woody debris (large snags/log structures) in rivers has been reduced. Most of the remaining habitats are affected by flow fluctuations associated with reservoir management, at least along the larger rivers and streams.[257] Anadromous fish typically spend from a few months to three years rearing in freshwater tributaries, with thirty-two sub-basins provide spawning and rearing habitat. Other fish and wildlife are associated with stream and river habitat for part or all of their life stages. The dams on the river system have directly and indirectly reduced spawning and rearing habitat quantity and quality.[258]
POLICY DIRECTION	
Status Quo	The amount of stream and river habitat increases, based on the purchase/lease of water rights from irrigators. These gains benefit mainly those fish and wildlife that use the tributary habitat. Actions taken are similar to those described under Status Quo for the Instream Water Quantity effects. Other actions are taken to improve existing habitat. Some tributaries still lose habitat during dry months or low water years.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Much more stream and river habitat would be created by the breaching and/or drawdown of six reservoirs. Nevertheless, the quality of habitat would vary seasonally. Some quality habitat would be lost in the short term from increased sedimentation and, in the long term, from elimination of reservoir shorelines. The

[256] See Section 5.2.2.1 Land of this EIS.

[257] See Section 5.2.2.1 Land of this EIS.

[258] Corps 2002b, Section 4.5.1 Anadromous Fish.

EFFECT AREA: WATER HABITAT: Amount of Stream/River Habitat more = better	
	inability to regulate flows during the dry seasons could decrease the amount of habitat available for fish in those affected areas. However, quality habitat would develop naturally, based on the restriction of land use activities on stream/river adjacent lands. Drawdown would also cause some loss of shallow water habitat. For example, extensive shallow water habitat in the John Day Reservoir would be lost, which could substantially reduce the natural production of upriver bright fall chinook salmon, the only healthy stock of anadromous fish remaining in the upper Columbia River Basin.[259] Overall, there would be much better stream/river habitat compared to Status Quo, although potentially lower habitat quality in the short term.
Weak Stock Focus	More stream and river habitat would be created by breaching the lower Snake River Dams; however, the quality of habitat would vary seasonally. Breaching dams would result in more natural river conditions. For example, breaching the four lower Snake River dams and eliminating the reservoirs would result in a 140-mile near-natural river.[260] Such factors as excess sedimentation would cause a short-term loss in quality habitat. The inability to regulate flows during the dry season would decrease the amount of habitat available for fish in the affected areas. Drawdown might provide slightly more rearing habitat for species such as fall chinook salmon, resulting in greater production potential.[261] Other actions, including those described under Instream Water Quantity effects, would be taken to acquire more water for instream habitat use. Other actions to enhance stream/river habitat to benefit weak stocks would be implemented. Degraded river/stream habitat would be enhanced to benefit listed species. Overall, there would be more stream/river habitat than under Status Quo.
Sustainable Use Focus	Increases in instream water quantity through the purchase or lease of water rights would create some increase in habitat, especially in the tributaries. Flow augmentation during the drier months could increase the amount and quality of habitat available during that time. Active management efforts would increase available habitat for fish and wildlife. Overall, there would be more stream/river habitat than under Status Quo.
Strong Stock Focus	Any increases in stream/river habitat would be focused in areas important to strong stocks, while efforts for weaker stocks would be de-emphasized.. Habitat would be maintained at existing levels in order to ensure that the healthy stocks remain strong. Habitat could be maintained through the purchase of water rights in order to offset new withdrawals. Overall, there would be about the same amount of stream/river habitat as under Status Quo.
Commerce Focus	The amount of stream/river habitat would likely either increase or decrease in site-specific locations, based on the commercial benefits of maintaining a certain amount of habitat for recreational revenues. Habitat in areas suitable for development would likely be lost as a result of increased water withdrawals. There would likely less stream/river habitat than under Status Quo.

[259] Corps 2000, Section 7.17.1 Potential Effects on Juvenile Salmonids.

[260] Corps 2002b, Section 3.4 Alternative 4—Dam Breaching.

[261] Corps 2002b, Section 7.17.1.3 Habitat Changes.

EFFECT AREA: WATER HABITAT: Amount of Reservoir Habitat more = better	
Existing Conditions	The main issues for fish and wildlife management concerning reservoir habitat is reservoir operations, which can increase or decrease the available aquatic habitat. Reservoir operations can affect water temperature, velocity, and sedimentation. Reservoir habitat can be lost as a result of irrigation and domestic use withdrawals, droughts, and flow modifications to the hydrosystem. The FCRPS consists of 31 dams with hydropower facilities on the Columbia River and its tributaries.[262] There are 14 major Federal dams on the mainstem Columbia and lower Snake Rivers, 12 operated by the Corps and 2 operated by the Bureau. Overall there are 255 Federal and non-federal projects in the Basin. Although some of these are considered run-of-river dams, others maintain large reservoirs for flood control, irrigation, and other uses. Generally, the amount of reservoir habitat is related to the amount of water storage. Some of the large reservoirs have a large amount of reservoir habitat. For example, the reservoir behind the Grand Coulee Dam stores approximately 5.19 MAF of water, while the reservoir behind the Libby Dam stores 4.98 MAF.[263] While run-of-river dams maintain limited reservoirs much smaller than those of the larger storage reservoirs. For example, the reservoirs behind Lower Granite and Ice Harbor dams have a normal operating capacity of 49,000 AF and 25,000 AF, respectively.[264] Reservoir habitat can be charaterized as either open water or back water. The loss of reservoir habitat should be examined as it relates to the surface area that would be reduced, the overall reduction in volume, and changes in associated habitat features. Reservoirs provide both surface habitat and water column habitat for certain species of fish, other aquatic organisms, and wildlife. For example, some species of waterfowl and raptors (e.g., bald eagles and osprey) benefit from the large open waters and shallow areas of reservoirs, while diving waterfowl and native resident fish benefit from the water column habitat. However, reservoirs can also adversely affect certain species of anadromous fish, by causing extended travel times, residualization (failure to migrate), and decreased survival rates.[265]
POLICY DIRECTION	
Status Quo	The amount of reservoir habitat would continue to fluctuate seasonally to allow for improved anadromous fish migrations, and in response to irrigation and domestic use withdrawals. In 1995, 1998, and 2000, the NMFS issued BiOps for the operation of the FCRPS. These BiOps outlined actions to be implemented specifically relating to reservoir management. For example, NMFS requested that three of the lower Snake River reservoirs be operated within 1 foot of the reservoirs' MOP from April 3 until adult fall chinook enter the Snake River, and that all four reservoirs be operated within their normal ranges after November 15.[266] Water withdrawals also potentially result in lost reservoir habitat. For example, the water supply directly or indirectly affected by the John Day reservoir, excluding large-scale irrigation, was recently estimated at about 2,200 wells, mainly used for domestic use.[267] Also, irrigation withdrawals from the reservoir have been estimated

[262] Corps 2002b, Section 4.1.1 Physical Environment.

[263] USDOE/BPA 2001b, p.14.

[264] Corps 2002b, Section 2.1 Project Characteristics.

[265] Corps 2000, Section 4.18.7 Reservoir Passage.

[266] Corps 2002b, Section 2.1.3 Reservoir Operation Levels.

[267] Corps 2000, Section 4.14 Water Supply.

EFFECT AREA: WATER HABITAT: Amount of Reservoir Habitat more = better	
	at more than 1.2 million gallons per minute (gpm) from a total of 30 pump stations.[268] Some water rights have been obtained through leases to be used for instream benefits.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Breaching six dams would decrease the amount of reservoir habitat. The direct loss of reservoir habitat could improve habitat conditions for some listed anadromous and resident species of fish; however, in the short term, the dam removal process would adversely affect all aquatic species through reduced water quality. Wildlife species would also be affected in both the short and long term. (See Fish and Wildlife Section, below.) The removal of dams would affect large sections of the Columbia and lower Snake rivers. The John Day reservoir, the second longest reservoir on the Columbia River, extends 76 miles, while the McNary Dam reservoir extends approximately 62 miles.[269] Removal of the lower Snake dams would create 140 miles of near-natural river.[270] Large losses of both reservoir surface and water column habitats would be expected. For instance, removal of the six dams would result in a loss of more than 100,000 acres of reservoir surface area, and more than 800,000 AF of water.[271] Overall, the amount of reservoir habitat would be much worse than under Status Quo.
Weak Stock Focus	Flow management targeted for ESA-listed anadromous fish and the removal of four dams would decrease the amount of reservoir habitat. The direct loss of reservoir habitat could improve habitat conditions for some listed anadromous and resident species of fish; however, in the short term, the dam removal process would adversely affect all aquatic species. Wildlife would also be affected in both the short and long term. Measures would be taken to enhance newly created habitat to benefit ESA-listed species. (See Fish and Wildlife Section, below.) For example, removal of the four dams on the lower Snake River would result in the loss of almost 14,000 surface acres of reservoir habitat and approximately 143,000 AF of water,[272] potentially creating 140 miles of near-natural river in the lower Snake River.[273] Flow management could include changes in timing and duration of releases from other dams, resulting in fluctuations in reservoir habitat. There would be less reservoir habitat than under Status Quo.
Sustainable Use Focus	The amount of reservoir habitat would continue to fluctuate from changes in flow management intended to benefit fish. Water rights acquired from agricultural lands and water left instream for fish and wildlife could temporarily increase the amount of reservoir habitat. However, some storage would be used to increase flows during fish migrations. Overall, the amount of reservoir habitat would be the same as Status Quo.
Strong Stock Focus	Hydro restrictions would be reduced, so long as they do not affect strong stocks. Reservoir habitat could fluctuate, based on the operation of the dams for their

[268] Corps 2000, Section 4.13 Irrigation.

[269] Corps 2000, Section 3.2 Description of the Study Area; Corps 1999b.

[270] Corps 2002b, Section 5.6.1.3 Alternative 4—Dam Breaching.

[271] Corps 2000, Section 3.2 Description of the Study Area; Corps 1999b; Corps 2002b, Section 5.6.1.3 Alternative 4—Dam Breaching.

[272] Corps 2002b, Section 5.6.1.3 Alternative 4—Dam Breaching; and Section 2.1 Project Characteristics, Table 2-1.

[273] Corps 2002, Section 5.6.1.3 Alternative 4—Dam Breaching.

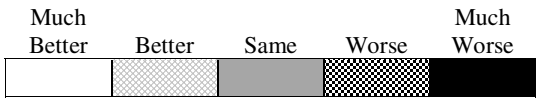
EFFECT AREA: WATER HABITAT: Amount of Reservoir Habitat more = better	
	authorized purposes. More water would be stored. Spill for weak stocks would be eliminated and it is likely that less spill would be required to maintain the strong stocks of fish. Overall, there would be more reservoir habitat than compared to Status Quo.
Commerce Focus	Reservoir levels and habitat would change in response to the best economic use of the water. More water would be stored. If spill for fish did not achieve commercial benefits, it would likely be discontinued, resulting in more storage for power production, irrigation, or other valuable uses. There would be more reservoir habitat than under Status Quo.

5.3.2.4 Fish and Wildlife

Table 5.3-4A shows how the various Policy Directions would affect native anadromous fish, native resident fish, and native wildlife. The potential effects of non-native species on native species are also shown. In all cases, effects are shown by shading to indicate whether a given Policy Direction would tend to have effects that are the same as, better than, or worse than Status Quo. In general, increases in native fish and wildlife species are characterized as "better" in the table.

Table 5.3-4A: Fish and Wildlife Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Naturally-spawning Native Anadromous Fish[274]						
Hatchery-produced Native Anadromous Fish						
Native Resident Fish						
Native Wildlife[275]						
Non-native Species						



[274] Suspended sediment resulting from dam breaching could have adverse effects on all aquatic organisms present in-river, particularly during the first 5-year period; however, over the long term the situation would improve. Corps 2002b, at Section 5.5.1.4 Alternative 4—Dam Breaching.

[275] If Dam Breaching were chosen, some unavoidable adverse impacts to plant communities would occur in the short term, including direct loss due to scouring and sloughing and indirect loss due to competition from exotic species. Corps 2002b, at Section 5.6.1.3 Alternative 4—Dam Breaching.

Summary of Effects: Dam breaching, under the Natural Focus Policy Direction would restore natural river conditions in some reaches and expose previously inundated lands. Naturally-spawning native anadromous fish, as well as native resident fish would benefit under this Policy Direction. Native wildlife would benefit from the newly exposed habitat and restrictions on access. Hatchery-produced anadromous fish would be much worse under this Policy Direction because the hatchery program would be eliminated. Under Natural Focus, impacts to native fish and wildlife from non-native species are worse as populations of non-native species increase due to the lack of human intervention.

Under the Weak Stock Policy Direction, management strategies intended to recover listed species would benefit most native fish and wildlife. Conditions would be better for both naturally-spawning anadromous fish and hatchery-produced anadromous fish, as habitat is increased, predation decreased, and hatchery production shifts to a conservation focus. Native resident fish do much better because benefits are gained from increased habitat, improvements to the hydrosystem, elimination of non-native species competition, and hatchery modifications. Native wildlife, also do much better under this Direction because of direct programs to enhance habitat, increasing wildlife numbers and reducing non-native competitors. The impact on native species from non-native species is less under this Direction.

The Sustainable Use Focus Policy Direction would benefit all native fish and wildlife by rebuilding and maintaining habitat, modifications to the hydrosystem, and managing undesirable species. Hatchery-produced anadromous and resident fish increase as hatcheries are used for supplementation purposes. Some undesirable non-native species are reduced, while other desirable non-native species are managed to increase in numbers resulting in conditions similar to Status Quo.

Overall, the Strong Stock Focus would result in conditions worse than Status Quo for naturally-spawning anadromous fish as focus shifts to maintaining strong stocks. Hatchery-produced anadromous fish would do better as hatcheries are used to supplement strong stocks. Native resident fish would likely decline compared to Status Quo despite the use of hatcheries. Native wildlife populations would be managed to keep populations strong. Weak populations would continue to decrease. Therefore there would be some loss of species diversity, however overall wildlife abundance would be better than under Status Quo. Non-native species impacts would likely increase resulting in worse conditions for native fish than under Status Quo. Non-native species would likely increase as the health of strong stocks/populations is encouraged, whether the species is introduced or not, however, impacts to native wildlife would be similar to Status Quo.

Under the Commerce Focus Policy Direction, naturally-spawning anadromous fish would be much worse than under Status Quo, as less emphasis is placed on recovering weak stocks. Hatchery-produced anadromous fish would do much better as artificial production through hatcheries and fish farms is emphasized. Some native resident fish would do worse as more value is placed on anadromous fish. Under Commerce Focus, wildlife would also do worse compared to Status Quo, though commercially valuable

species would do better. Non-native species would be reduced to benefit more valuable native species, therefore, native fish and wildlife would be better than under Status Quo.

The reasoning for these effects is described in greater detail in Table 5.3-4B.

Table 5.3-4B: Fish and Wildlife Effects Across the Policy Directions Analysis

EFFECT AREA: FISH AND WILDLIFE: Native Anadromous Fish (Naturally-Spawning and Hatchery-Produced) more fish = better	
Existing Conditions	The main concerns regarding native anadromous fish include ocean conditions, loss of habitat, over-harvest, and hydro operations. Also, there is some concern that problems arise from the interaction between naturally-spawning and hatchery-produced native anadromous fish. Since European-American settlement of the Pacific Northwest, anadromous fish populations have declined. Annual runs of salmon and steelhead returning to the Columbia River were estimated at between 8 and 16 million fish before settlement, but had declined to approximately 2.5 million fish by the early 1980s.[276] Population sizes of the different stocks of salmon vary substantially, as a result of natural and human-caused mortality factors. During the 1970s, when all the lower Columbia River and lower and middle Snake River dams (Federal and non-federal) were completed, the estimated in-river survival rate for spring/summer chinook salmon was 5-40%.[277] However, system survival rates indicate that in-river survival has increased up to 62% for spring/summer chinook—as high as it was when only four dams were in place in the Columbia and Snake Rivers in the 1960s.[278] The proportion of hatchery fish found in the river system has steadily increased. Hatcheries in the Pacific Northwest produced fish primarily for sport, commercial, and tribal harvest. With the increase in hatchery production, the proportion of wild fish decreased from about 75% in the 1970s to about 25% by the mid- to late-1980s.[279] The passage of the ESA as well as of the Regional Act resulted in the creation of Federal duties to protect, mitigate, and enhance fish and wildlife affected by Federal hydroelectric projects and to ensure that those species listed under the ESA were not jeopardized by Federal actions.[280] The species of salmon in the Pacific Northwest include pink, coho, chinook, chum, and sockeye, as well as steelhead trout. However, these species are divided further into ESUs under the ESA, based on certain criteria. Many of these ESUs are listed as threatened or endangered, with few healthy wild (naturally-spawning) ESUs remaining. As of 2001, there were 17 listed ESUs of salmon and steelhead in the Pacific Northwest (3 listed as endangered and 14 as threatened; 12 ESUs listed in the Columbia/Snake River system).[281] Other species of anadromous fish found in the Pacific Northwest include the Pacific lamprey, some sturgeon, and the non-native American Shad.

[276] Corps 2002b, Section 4.5.1 Anadromous Fish**.**

[277] Corps 2002b, Section 6.4.2.1 Aquatic Resources—Anadromous Fish.

[278] Corps 2002b, Section 6.4.2.1 Aquatic Resources—Anadromous Fish.

[279] Corps 2002b, Section 4.5.1.2 Anadromous Fish: Run Status.

[280] See Chapter 2 of this EIS for descriptions of the Acts.

[281] Endangered Species Status of West Coast Salmon and Steelhead, available at http://www.nwr.noaa.gov/ (last visited February, 2003).

EFFECT AREA: FISH AND WILDLIFE: Native Anadromous Fish (Naturally-Spawning and Hatchery-Produced) more fish = better	
POLICY DIRECTION	
Status Quo	In 2001, the Columbia River Federal Basinwide Salmon Fund expenditures for salmon recovery by the regional Federal agencies (Corps, BLM, Bureau, USFWS, BIA, USGS, NMFS, USFS, and EPA), were about $350 million. Bonneville's ratepayers funded more than $180 million of that total.[282] Major policies shaping salmon management are defined and guided by mitigation requirements, the Regional Act, the ESA, tribal fishing rights, and international treaties. However, there is no unified policy direction among all the interested parties, and science offers no clear and agreed-upon answer to the problem. Even with the expenditures noted above, certain ESUs continue to decline for a variety of reasons—and expenditures are increasing. Anadromous fish populations vary erratically, their numbers and health driven by ocean and freshwater harvest, ocean and freshwater survival conditions, and weather cycles. Efforts are made to protect and enhance habitat for anadromous fish. Water-quality-limited salmon runs may be enhanced through streambank protection via the use of buffers. Hatcheries are used primarily to mitigate the effects of the hydro system and support harvest. For example, hatcheries operated to mitigate for the John Day Reservoir produce approximately 11.9 million fall Chinook smolts annually, four times greater than the original anticipated loss and agreed upon mitigation.[283] Some hatcheries, however, are used to meet conservation goals.[284] For example, BPA implements a number of conservation hatchery programs, including the program for Snake River sockeye salmon, which keep the genomes alive in stocks that are virtually extinct in the wild.[285] Hydro operations are guided by NMFS' BiOps. Structural modifications are made to the dams to improve passage for the benefit of anadromous fish. Flow augmentation, spill, and transportation of juveniles fish are also used to benefit anadromous fish. Given the numerous parties involved with anadromous fish policy, it is unclear whether salmon populations will increase to sustainable levels.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The drawdown of reservoirs or removal of six dams would result in short and long-term effects on anadromous fish. Short-term adverse effects would include elevated suspended sediment, reduced rearing habitat, and reduced migratory habitat quality. Some of these short-term effects could result in increased mortalities, although it is unclear what the effect would be for lamprey. Beneficial effects might include reduced predation of juveniles and increased migration times.[286] Some long-term effects include reduced passage mortality, a decrease in dissolved oxygen levels, a decrease in predation rates on juveniles, and an increase in the amount of riverine habitat.[287] Whether certain populations of anadromous fish would be able to persist past the short-term effects is uncertain. Access to protected quality habitat would be

[282] USDOE/BPA 2002e.

[283] Corps 2000, Section 4.18.4 Hatchery Production.

[284] Supplementation - Artificial propagation intended to reestablish a natural population or increase its abundance. (Federal Caucus 1999b, Glossary, p. 100).

[285] A detailed history and current status of hatcheries, emphasizing their roles for mitigation and production, can be found in the Federal Caucus 2000b, pp. 52-66 and in the associated Hatchery Appendix.

[286] Corps 2002b, Section 5.5.1.4 Alternative 4—Dam Breaching.

[287] Corps 2002b, Section 5.5.1.4 Alternative 4—Dam Breaching.

EFFECT AREA: FISH AND WILDLIFE: Native Anadromous Fish (Naturally-Spawning and Hatchery-Produced) more fish = better	
	prohibited or very reduced, allowing for natural habitat improvements. The phase-out of hatcheries and focus on wild anadromous fish would reduce the overall number of fish in the river. Harvest would be reduced overall to restore naturally-spawning native anadromous fish. These efforts would likely recover certain populations in the long run, with several caveats: natural conditions may not be attainable in decades or ever; harvest may not be completely controllable (other nations may continue to allow harvest); weather and ocean conditions may not be favorable, and some genetic stocks are permanently lost. Even with maximum implementation actions, it is likely that fish populations would not approach pre-European settlement levels. Over the long term, however, abundance of some naturally-spawning fish would be much better than under Status Quo; hatchery-produced native anadromous fish would be much worse.
Weak Stock Focus	The resevoir drawdown or removal of four dams would result in short- and long-term effects on anadromous fish. Short-term adverse effects would include elevated suspended sediment, reduced rearing habitat, and reduced migratory habitat quality. Some of these short-term effects could result in increased mortalities, although it is unclear what the effect would be for lamprey. While immediate beneficial effects might include reduced predation of juveniles and increased migration times,[288] some long-term effects could include reduced passage mortality, an increase in dissolved oxygen levels, and an increase in the amount of riverine habitat.[289] Whether certain populations of anadromous fish would be able to persist past the short-term effects is uncertain. Other actions in conjunction with dam removal would be implemented to benefit listed species. These could include active habitat improvements, harvest controls (e.g., a shift to selective harvest), and hatchery management. For example, more habitat critical to listed anadromous fish would be enhanced. Also, overall harvest of weak stocks would be further restricted. Hatcheries would be managed primarily for conservation purposes and not supplementation. However, even under this Policy Direction, populations of anadromous fish would not increase to pre-European settlement levels. Overall, there would be more naturally-spawning and hatchery-produced native anadromous fish than under Status Quo.
Sustainable Use Focus	Efforts would be made to rebuild and manage anadromous fish habitat to enhance production and maintenance of harvestable levels of anadromous fish, including habitat for lamprey. Management of undesirable fish species to benefit anadromous fish could include such methods as changes in angling regulations, physical removal (e.g., nets, traps, or electrofishing), the use of piscicides (e.g., rotenone and antimycin), dewatering and stream flow augmentation, and habitat manipulation techniques. Modifications would be made to the hydro system to further increase survival of anadromous fish. For example, new technology (e.g., removable spillway weirs and extended submerged bar screens) might be installed to assist in fish passage and to decrease passage-caused mortality.[290] Transporting fish would also be used to assist in fish passage. Hatchery production would increase to supplement the naturally-spawning salmon populations to benefit harvest. Hatchery programs would be designed to avoid the loss of genetic diversity while maintaining sufficient numbers of fish for harvest. It is unclear whether all these improvements would benefit lamprey, though they would benefit from screening. Compared to

[288] Corps 2002b, Section 5.5.1.4 Alternative 4—Dam Breaching.

[289] Corps 2002b, Section 5.5.1.4 Alternative 4—Dam Breaching.

[290] Corps 2002b, at Section 5.5.1.3 Alternative 3—Major System Improvements.

EFFECT AREA: FISH AND WILDLIFE: Native Anadromous Fish (Naturally-Spawning and Hatchery-Produced) more fish = better	
	Status Quo, naturally-spawning and hatchery-produced fish would increase with habitat, hatchery, and harvest improvements.
Strong Stock Focus	There would be an emphasis on managing strong stocks of anadromous fish. Weaker stocks would be allowed to continue to decline, while stronger stocks would be supported through habitat maintenance and hatchery production. Stocks in the Columbia River mainstem would be emphasized. Restrictions on hydrosystem operations would be decreased, unless operations were adversely affecting strong stocks. In most years, the unimpounded Hanford Reach of the Columbia River would be managed much as it is under Status Quo. Hatcheries would be operated to support strong stocks of anadromous fish; sustainable fish harvest would increase overall. Because there would be a loss in genetic diversity as weak stocks decline, there would be less naturally-spawning native anadromous fish than Status Quo. However, there would be more hatchery-produced native fish than under Status Quo.
Commerce Focus	The focus would be on producing a commercially viable salmon harvest using least-cost production, primarily hatcheries and fish farming. Less emphasis would be placed on the importance of native stocks, and some weak stocks might become extinct. The management of stocks in the Columbia River mainstem would be emphasized. Total run size would increase, however, naturally-spawning runs would decrease. Overall, populations of naturally-spawning native anadromous fish would be much worse under this alternative than under Status Quo. Hatchery-produced native anadromous fish would be much better compared to Status Quo, given increases in artificial production.

EFFECT AREA: FISH AND WILDLIFE: Native Resident Fish more fish = better	
Existing Conditions	The main concerns relating to native resident fish include habitat loss and degradation, competition with and predation from introduced species, and the effects of management focused on harvest and the recovery of listed anadromous fish. Some native resident fish species, including bull trout, redband trout, mountain whitefish, burbot, and white sturgeon, are in decline. For example, by 1994, Kootenai River white sturgeon had been listed pursuant to the ESA as endangered.[291] Similarly, by 1999 all five of the distinct population segments of bull trout had been listed as threatened under the ESA.[292] Bull trout are estimated to have historically occupied about 60% of the Columbia River Basin; however, in 1998 they were estimated to occur in only 4% of its estimated historical range.[293] Cold-water resident species such as trout and mountain whitefish have declined since construction of the dams.[294] The dams have blocked spawning migrations of resident

[291] Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Kootenai River Population of the White Sturgeon 59 Fed. Reg. 45989, 46002 (Sept. 6, 1994).

[292] Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Klamath River and Columbia River Distinct Population Segments of Bull Trout, 63 Fed. Reg. 31647, 31674 (June 10, 1998); Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Jarbidge River Population Segment of Bull Trout, 64 Fed. Reg. 17110, 17125 (April 4, 1999); Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Bull Trout in the Coterminous United States, 64 Fed. Reg. 58909, 58933 (Nov. 1, 1999).

[293] USDOI/USFWS 1998b.

[294] Corps 2002b, Section 4.5.2.1 Species Composition.

EFFECT AREA: FISH AND WILDLIFE: Native Resident Fish more fish = better	
	fish, modified the habitat, and affected species composition.[295] A change in prey organisms might also be a reason for the decline of some cold-water resident species.[296] However, other native resident species (e.g., the northern pikeminnow, largescale sucker, and bridgelip sucker) are found in reservoirs in high numbers. For example, age one and older bridgelip sucker, redside shiner, largescale sucker, and northern pikeminnow accounted for about 70% of all fish sampled in 1979 and 1980 in Lower Granite reservoir.[297] Species such as the northern pikeminnow have been and are being actively harvested for the benefit of anadromous species.[298]
POLICY DIRECTION	
Status Quo	Resident fish face continuous pressure from intense efforts to recover anadromous fish, from habitat loss or degradation, and from introduced species. The USFWS has issued BiOps concerning the effect of human activities (e.g., land management and hydro operations) on listed resident fish. Efforts have been made to improve habitat conditions and increase specific resident species. For example, Oregon's 1999-2001 adopted budget for its natural production program (focused on habitat rehabilitation and fish management) totaled approximately $45 million, although this money is meant to benefit anadromous fish as well.[299] Populations of other resident native species are larger than historical populations, and where these large population levels have been identified as undesirable; intense management programs have been initiated to reduce their numbers. For example, a bounty has been placed on the northern pikeminnow in order to reduce its numbers and predation on juvenile salmonids.[300] Although some native resident fish (e.g., white sturgeon) benefit from ESA-driven habitat restoration and hatchery measures, management priority is largely for anadromous fish.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Native resident fish could benefit from habitat protection, discontinuation of hatcheries, and decreasing of harvest. The drawdown of reservoirs or removal of six dams would improve conditions for some species, while others might be adversely affected. For example, redsided shiner production would likely increase, and benefits might be achieved in white sturgeon production.[301] However, white sturgeon rearing conditions might not improve.[302] Opportunistic species would increase, while those species less adaptable would be eliminated (survival of the fittest). For example, northern pikeminnow populations might increase slightly though they would be restricted to the slower-moving water areas. Predation on juvenile salmonids might decrease as water velocity and turbidity increase.[303] Short-term negative effects of dam breaching could include stranding, increased predation in off-channel mitigation ponds and other embayments, changes to spawning habitat,

[295] Corps 2002b, Section 4.5.2.1 Species Composition.

[296] Corps 2002b, Section 4.5.2.1 Species Composition.

[297] Corps 2002b, Appendix B: Section 3.3.2 Historical and Current Distribution and Abundance.

[298] Corps 2002b, Section 4.5.2.3 Aquatic Food Chain.

[299] State of Oregon 2001.

[300] Oregon Administrative Rule 635-011-0175, Special Northern Pikeminnow Bounty Fishery.

[301] Corps 2000, Section 7.17.7 Potential Impacts on Resident Fish and Habitat.

[302] Corps 2000, Section 7.17.7 Potential Impacts on Resident Fish and Habitat.

[303] Corps 2000, Section 7.17.7 Potential Impacts on Resident Fish and Habitat.

EFFECT AREA: FISH AND WILDLIFE: Native Resident Fish more fish = better	
	and initial increased turbidity that could reduce feeding, growth, and reproduction and could have lethal effects for limited periods.[304] Long-term effects would include considerable changes in the amount and type of resident fish habitat, corresponding changes in the structure of the fish community, and some increased effects from flow augmentation.[305] Overall, there still does not appear to be scientific consensus on the effect of dam removal on the resident fish community.[306] Quality habitat would be protected, although the slow pace of passive restoration and species recolonization would limit improvements. There might be some improvements in habitat achieved by reducing human activity within specified areas and decreasing allowable harvest. All hatcheries would be discontinued, including those that produce non-native fish (e.g., brown trout), a step that could decrease predation and competition for resources, providing a benefit for native resident fish. There would be more native resident fish under this Policy Direction than compared to Status Quo.
Weak Stock Focus	Listed native resident fish would benefit from specific actions taken to assist in their survival and recovery. The drawdown or breaching of four dams would create both short- and long-term effects on native resident fish similar to those discussed under Natural Focus above. Certain weak species, such as white sturgeon, could benefit from dam removal and the return to a natural river condition.[307] Other weak native resident species, such as bull trout, could increase their usage of these previously impounded areas, depending on summer temperatures.[308] However, there still does not appear to be scientific consensus on the effect of dam removal on the resident fish community.[309] Additional measures would be taken to improve weak stocks and assist in their recovery; these steps could include the restoration of weak-stock habitat, further modifications of and limits on the hydrosystem, and management of hatcheries with a focus on conservation. This change in hatchery function could eliminate competition of hatchery-produced introduced species (e.g., brown trout) with listed resident fish. Any harvest of listed native resident fish or commercial activity that affects listed native resident fish would be decreased. Overall, there would be substantially more native resident fish under this Policy Direction than under Status Quo.
Sustainable Use Focus	Measures would be taken to improve conditions for both listed and non-listed fish as well as for native and non-native fish. Enhancing production and maintaining harvestable levels of resident fish would be emphasized. Desirable resident fish could be supplemented by hatchery operations. When possible, native resident fish would be prioritized over non-native fish; however, the need for a sustainable fishery and regional interests would dictate the target resident species. Management for resident species could take priority over management for anadromous species in certain areas, such as blocked anadromous fish habitat. Sustainable harvest levels would be achieved through managing predation, human activities, and habitat improvements. Management of undesirable fish species to benefit resident fish could include such methods as changes in angling regulations, physical removal (e.g., nets, traps, or electrofishing), the use of piscicides (e.g., rotenone and

[304] Corps 2002b, Section 5.5.2 Resident Fish, Table 5.5-11.

[305] Corps 2002b, Section 5.5.2 Resident Fish, Table 5.5-11.

[306] Corps 2002b, Section 5.5.2.4 Effects of Alternatives.

[307] Corps 2002b, Section 5.5.2.4 Effects of Alternatives.

[308] Corps 2002b, Section 5.5.2.4 Effects of Alternatives.

[309] Corps 2002b, Section 5.5.2.4 Effects of Alternatives.

EFFECT AREA: FISH AND WILDLIFE: Native Resident Fish more fish = better	
	antimycin), dewatering and stream flow augmentation, and habitat manipulation techniques. Modifications to benefit targeted resident fish would also be made to hydrosystem operations. Native resident species would increase relative to Status Quo, unless they were limited by requirements for anadromous fish stocks or other desirable fish species.
Strong Stock Focus	As management efforts shift to maintain strong stocks, weak native resident fish species would continue to decline. Hatcheries would be used to maintain strong populations for harvest. Increases in non-native fish species could result in the loss of more native resident fish through competition and predation. Some native resident fish could decline, as positive effects of weak-stock management were lost. Harvest would also increase, so long as the healthy, strong populations were not adversely affected. Overall, native resident fish species would likely decline as compared to Status Quo.
Commerce Focus	Comparative economic values of fish, wildlife, and commercial uses would control species management. More user fees for fishing would be used to improve habitat for valuable native resident fish species. Measures selected for implementation would be based on cost/benefit analysis. Hatchery production of marketable native resident fish would likely increase. Less effort would be focused on weak species such as bull trout. Overall, there would be fewer native resident fish than compared to Status Quo.

EFFECT AREA: FISH AND WILDLIFE: Native Wildlife more wildlife = better	
Existing Conditions	The main concerns regarding native wildlife relate to the loss of habitat as a result of human activities and inter-specific competition with introduced species. Native wildlife species vary in degrees of health and abundance. Some species are listed as threatened or endangered, others are substantially diminished, while still other populations are healthy and increasing. Some wildlife species require undisturbed habitats, and others have flourished in modified habitats. Many species continue to be adversely affected by economic growth, urbanization, and habitat fragmentation. Declines in plants and terrestrial vertebrates are attributable to a number of human causes, including conversion of habitat to agriculture, urban development, grazing, timber harvest, introduction of exotic plant and animal species, recreation, high road densities, and mining. Fragmentation has isolated some animal and plant habitats and populations and reduced the ability of populations to disperse across the landscape, resulting in potential, long-term loss of genetic interchange.[310] The ESA has protected some native wildlife by listing them as either threatened or endangered and by designating critical habitat; these actions are expected to ensure the survival and recovery of these species, resulting ultimately in their delisting. Bird species listed as threatened or endangered include the bald eagle, spotted owl, and marbled murrelet. Listed mammals include the Canada lynx, woodland caribou, grizzly bear, Columbian white-tailed deer, and gray wolf.[311]

[310] USDA/USFS and USDOI/BLM 2000b, Chapter 2 Terrestrial Species.

[311] See Appendix C of this EIS.

EFFECT AREA: FISH AND WILDLIFE: Native Wildlife more wildlife = better	
POLICY DIRECTION	
Status Quo	Between 1983 and 2001, BPA spent approximately $145 million on wildlife mitigation, acquiring and enhancing habitat to offset habitat lost as a result of the Federal hydrosystem.[312] Listed species are protected and managed through Federal ecosystem management policies and private initiatives. Mitigation measures such as the construction of avian-friendly facilities and construction of nest boxes can reduce negative effects and can improve conditions for some species. Native wildlife also benefit from actions taken to protect and manage fish. Many non-listed species are regulated and managed by individual states for recreational purposes (e.g., hunting, bird watching). For example, between 1997 and 1999, the Oregon Department of Fish and Wildlife spent approximately $27 million on game and non-game species and habitat improvement and maintenance.[313] Habitat actions included the creation and/or substitution of habitat based on Habitat Evaluation Procedures or other credit valuation methods, and memoranda of agreement between government entities.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The creation of more land habitat through dam breaching, land retirement, and passive restoration would result in wildlife tradeoffs in the short and long-term. For example, direct impacts from the breach of the six dams would cause an immediate loss of habitat and/or increased predation on many waterfowl species (e.g., Canada goose, American coot), aquatic furbearers (e.g., beaver, river otter, mink, and muskrat), non-game birds (e.g., pied-billed grebe and red-winged black bird), neotropical migrants, colonial nesting birds (e.g., Caspian and Forster's terns), some raptors (e.g., great horned owl, and osprey), mule deer, and reptiles and amphibians (e.g., Western painted turtle and northern leopard frog).[314] Some species would benefit from the short-term increase in available prey species. Some shorebirds (e.g., American avocet) would benefit from exposed mudflats, while some mammalian predators could capitalize on new land connections to island waterfowl nest sites.[315] Restrictions on development and other human activities in protected areas would benefit wildlife in the long term. For example, new riparian and terrestrial habitat would be created from former reservoir bottoms, although the length of time for natural re-vegetation of the area is uncertain. In the short term, this Policy Direction would be much worse for native wildlife than Status Quo; however, in the long term it would be somewhat better than Status Quo.
Weak Stock Focus	The removal of four dams would result in both the short- and long-term effects similar to those discussed under Natural Focus. However, newly exposed lands would be actively managed and enhanced, decreasing the long-term effects on many wildlife species. Habitat protection and improvements would be focused on threatened and endangered species, resulting in increased numbers. There would be some incidental benefits to non-listed species (e.g., newly created habitat, avian-friendly facilities) in attempts to protect listed species. Other listed species would benefit directly from programs to control predators and, possibly, non-native competitors. Overall, there would be more native wildlife in the long-term compared to Status Quo.

[312] USDOE/BPA 2001f.

[313] State of Oregon 2001.

[314] Corps 2000, Section 7.18.2 Wildlife; Corps 2002b, Section 5.6.2 Wildlife.

[315] Corps 2000, Section 7.18.2 Wildlife; Corps 2002b, Section 5.6.2 Wildlife.

EFFECT AREA: FISH AND WILDLIFE: Native Wildlife more wildlife = better	
Sustainable Use Focus	Needs of listed species would be balanced with the needs of all species. More habitat mitigation and better management techniques would be used to enhance production, achieving harvestable populations of wildlife. Efforts could include rebuilding degraded habitat, improving existing habitat to increase production (e.g., planting food plots), reducing mortality (e.g., construction of avian-friendly facilities), and controlling predators and undesirable species. Management of undesirable wildlife species could include such techniques as relocation of problem individuals or populations, change in hunting regulations, physical removal/deterrence (e.g., shooting, trapping, water spray, and avian predator lines), biological/chemical controls (e.g., sterilization), and habitat manipulation. Habitat actions included the creation and/or substitution of habitat. This Policy Direction would likely result in more native wildlife than Status Quo.
Strong Stock Focus	Existing strong wildlife populations would be actively maintained and managed to keep populations robust to avoid unhealthy conditions. Harvest levels of wildlife could increase so long as strong, healthy populations are maintained. ESA-listed predators, including grizzly bears, Canada lynx, and wolves would likely decline as efforts to recover them are abandoned and resources are shifted to maintain strong species, in particular harvestable game species. This loss of predation would help to further increase strong populations of wildlife. Therefore some improvement in strong wildlife populations would be expected. Although there would be some loss of species diversity, overall wildlife populations would be better than under Status Quo.
Commerce Focus	Wildlife would be managed as a commodity. More user fees for hunting would be used to improve habitat for valuable species. Wildlife measures would be selected for implementation on the basis of cost/benefit analysis. Public benefit would be maximized from expenditures of finite wildlife enhancement funds. Emphasis would be placed on benefits and costs of artificial propagation and stocking of wildlife species. Increases in urbanization and industrialization would cause negative effects, although those species that habituate to human presence would increase. Overall, most native wildlife would be worse under this Policy Direction than under Status Quo; however, if a species were identified as commercially valuable, that species would be better off under this Alternative than under Status Quo.

EFFECT AREA: FISH AND WILDLIFE: Non-Native Species fewer non-native species = better	
Existing Conditions	Major concerns for native fish and wildlife from non-native species are predation, competition for resources, and habitat modification. Declines in fish and wildlife can be attributed to the introduction, whether intended or accidental, of exotic species.[316] The introduction of exotic species is second only to habitat loss as the reason for species decline. Regional non-native species include fish (e.g., American shad, walleye, smallmouth bass), mammals (e.g., opossum, eastern cottontail, nutria), amphibians (e.g., bullfrog), birds (e.g., ring-necked pheasant, Hungarian partridge, Chukar), mollusks (e.g., zebra mussels, oyster drill, New Zealand mudsnail), and crustaceans (e.g., European green crab, Chinese mitten crab). Some non-native species such as the zebra mussel have the ability to change entire ecosystems. Non-native species (e.g., Chukar and ring-necked pheasant) also have become established game species, generating hunting revenues and resulting in

[316] USDA/USFS and USDOI/BLM 2000b, Chapter 2 Terrestrial Species.

EFFECT AREA: FISH AND WILDLIFE: Non-Native Species fewer non-native species = better	
	specific habitat management goals to increase their numbers. Some non-native species introduced for sport fishing now prey on and compete with juvenile anadromous fish. There has been some attempt to regulate and prohibit the introduction of undesirable non-native species both locally and Federally. For example, in 1990 Congress passed the Nonindigenous Aquatic Nuisance Prevention and Control Act,[317] while in 1996 ODFW adopted specific rules to regulate and prohibit non-native wildlife.[318]
POLICY DIRECTION	
Status Quo	In the last century, there has been a large increase in the number of exotic species found in the Northwest. In fact, one-third of all species found in the Northwest are non-native.[319] For example, Oregon estimates that at least 96 non-native species exist in the wild, and, 62 of these species have become established and are believed to have self-sustaining populations.[320] The impact of these species on native fish and wildlife has been substantial. For example, between 1983 and 1986 the mean annual loss of juvenile salmon to predation was between 1.9 and 3.3 million fish. Walleye and smallmouth bass accounted for 21% of the mean annual loss.[321] The number of non-native, often harmful, populations continues to increase. For example, in the Umpqua River Basin there are an estimated 17 species of non-native sport fish compared to the 7 native species,[322] while there are estimated to be 18 non-native fish species in the lower Snake River reservoirs, as compared to the 17 native species.[323] Efforts to control undesirable non-native species and to prevent the introduction of any new, potentially harmful non-native species continue. However, management is still carried out to increase desirable non-native species in limited circumstances (e.g., Chukar, brown trout).
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam breaching would result in the loss or conversion of certain aquatic and terrestrial habitats for fish, mammals, birds, amphibians and aquatic invertebrates, among others. The loss of reservoir habitat would adversely affect both undesirable and desirable non-natives. The slow pace of passive restoration would do little to control the increase of established non-natives, but could slow introductions into undeveloped areas. Opportunistic species would increase, while less adaptable species would be eliminated. Overall, many established non-native species would increase under this Policy Direction; therefore, the effects would be worse for native fish and wildlife than under Status Quo.
Weak Stock Focus	With the removal of four dams, non-native species would experience habitat loss and related population declines. However, the removal or reduction of some non-native species through dam breaching might benefit some ESA-listed fish and wildlife.

[317] The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, 16 U.S.C. §§ 4701–4751 (2000).

[318] Importation, Possession, Confinement, Transportation and Sale of Nonnative Wildlife (Wildlife Integrity Program), OAR 635-056-0000 (1996).

[319] Palmisano, J.F. 2000a.

[320] ODFW (Oregon Department of Fish and Wildlife) 2001.

[321] Kaczynski and Palmisano 1993; Harza Northwest, Inc. 1996.

[322] Palmisano, J.F. 1997.

[323] Corps 2002b, Section 4.5.2.1 Resident Fish—Species Composition.

EFFECT AREA: FISH AND WILDLIFE: Non-Native Species fewer non-native species = better	
	Non-native species that prey, compete, or otherwise limit weak native species would be reduced. Populations of non-native species decline, especially in weak stock watersheds. Compared to Status Quo, native this alternative would be better for native fish and wildlife would because it reduces populations of non-native species.
Sustainable Use Focus	Undesirable non-native species would be actively managed to benefit the greatest number of targeted native fish and wildlife species. Management for undesirable non-native fish species could include such methods as changes in angling regulations, physical removal (e.g., nets, traps, or electrofishing), the use of piscicides (e.g., rotenone and antimycin), dewatering and stream flow augmentation, and habitat manipulation techniques. Non-native fish would be enhanced only under certain circumstances (for example, in areas that completely lack native fish and where native fish could not be reintroduced). Hatchery production would be used to provide sustainable fish harvesting, and could include non-native species. Management for undesirable non-native wildlife species could include such techniques as relocation of problem individuals or populations, change in hunting regulations, physical removal or deterrence (e.g., shooting, trapping, water spray, and avian predator lines), biological or chemical controls (e.g., sterilization), and habitat manipulation. Species-specific management would continue to maintain or increase some desirable non-native wildlife species. Management of undesirable non-native species would be conducted to minimize, when practical, the impact on non-targeted species. Overall, undesirable non-native species would decline and desirable non-native species would increase. Therefore, this alternative would have similar effects on native species of fish and wildlife as those under Status Quo.
Strong Stock Focus	There would be no distinction between native and non-native species, in terms of management actions. Non-native fish would increase because the river system would be managed for all strong fish populations, regardless of whether or not they are introduced. Healthy populations of desirable non-native wildlife also would benefit under this alternative. Populations of non-native species could increase to the extent they out-compete native species. Overall, non-native species would likely increase, so that conditions for native fish would be worse than under Status Quo, although conditions for native wildlife would likely be the same as Status Quo.
Commerce Focus	The comparative economic value of fish and wildlife would control species management, regardless of whether the species were native or introduced. Some non-native species would be allowed or encouraged to thrive, based on their economic potential. Other non-native species could be reduced or eradicated (e.g., using bounty programs) if they posed a potential economic threat to a commercially valuable native species. However, overall non-native species would be reduced to benefit more valuable native species (such as salmon), therefore native fish and wildlife would be better than under Status Quo.

5.3.3 Social and Economic Environments

The Policy Direction ultimately selected and implemented will result in environmental effects on the economic and social environments from fish and wildlife mitigation and recovery actions. Effects on the economic environment are grouped into the following effect area categories: commerce, recreation, economic development, and funding costs. Effects on the social environment are grouped into the following effect area categories: tribal interests, cultural and historic resources, and aesthetics. The effect area categories are further divided into subcategories and evaluated for each Policy Direction. The

anticipated effects associated with each Policy Direction are discussed throughout this section.

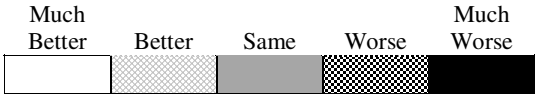
5.3.3.1 Economics

Table 5.3-5A shows how the Policy Directions would affect commerce, recreation, and economic development. Effects are shown, by shading, to indicate whether a given Policy Direction would tend to have effects that are the same as, better than, or worse than Status Quo. All economic effects are from the perspective of the industry. Each broad category is further divided into subcategories for evaluation. Fewer impacts on the industry are characterized as "better" in the table. Under recreation, more opportunities is characterized as "better" in the table. Employment effects for all industries are summarized in the economic development category. More employment is characterized as "better."

Table 5.3-5A: Economics Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Commercial Interests						
Power						
Transmission						
Transportation						
Agriculture, Ranching, and Forest Products						
Commercial Fish Harvest						
Other Industry (e.g. mining, Direct Service Industries [DSIs])						
Recreation						
Sport Fishing and Wildlife Harvest						
Other Recreation						
Economic Development						
Industrial, Residential, and Commercial Development						

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Employment						



Summary of Effects: The Natural Focus Policy Direction would be much worse for the commercial interests and economic development in the long term, primarily because of bam breaching. However, the effects on recreation would only be worse due to restricted access and the loss of river and reservoir recreation in certain areas.

In general, under Weak Stock commercial interests, recreation, and economic development are worse, primarily due to the effects of dam breaching and designating critical habitat for listed species.

The Sustainable Use Policy Direction would have effects on commercial interests similar to Status Quo, however, commercial fish harvest would be slightly better. Overall economic development is also about the same as Status Quo, although there may be slightly more employment opportunities. Overall, sport fishing and wildlife harvest under this alternative would be better than Status Quo, but other recreation would be about the same.

The Strong Stock Policy Direction would result in improved conditions for all of the commercial, recreation, and economic development subcategories when compared to Status Quo.

Commerce Focus would benefit all commercial, recreation, and economic development subcategories compared to Status Quo. Effects on other industry and employment would be much better than Status Quo.

The reasoning for these effects is described in greater detail in Table 5.3-5B.

Table 5.3-5B: Economic Effects Across the Policy Directions Analysis

EFFECT AREA: COMMERCIAL INTERESTS: Power less need for new resources = better	
Existing Conditions	The impacts to the power generation capability of the hydrosystem from changes to benefit fish are a major concern. The regional power firm resources are made up of hydro (55%), coal (19%), imports (8%), nuclear (5%), independent/small power producers (6%), combustion turbines (3%), and other miscellaneous resources (4%).[324] The Columbia River and its tributaries are extensively developed, with

[324] See Chapter 5 of this EIS, Section 5.2.3.1 Air Quality and Appendix E.

EFFECT AREA: COMMERCIAL INTERESTS: Power less need for new resources = better	
	more than 250 Federal and non-Federal dams constructed since the 1930s. These include 31 major multiple-use facilities built by Federal agencies on the Columbia River and its tributaries—the FCRPS.[325] BPA is the Federal power-marketing agency for the FCRPS. About 45% of the electric power used in the Northwest comes from BPA marketed resources.[326] Since 1995, hydrosystem operational requirements on the FCRPS for salmon recovery have reduced power generation in the Region by about 1000 MW. Most of the lost power has been replaced by higher-cost combustion turbines and power market purchases.[327] However, increasing population growth and demand are stressing existing generation, leaving fewer contingencies to meet fluctuations.
POLICY DIRECTION	
Status Quo	Between 1990 and 2000, the Region (OR, WA, ID, MT) experienced about a 21% growth in population; the Region has a projected growth of about 19% between 2000 and 2015.[328] With this population growth, the need for power increases. Between 2002 and 2011, the regional firm loads are projected to grow by nearly 2,400 aMW.[329] The recent recession, if it continues, may moderate this increase. The increased electrical demand is likely to be met mostly with combustion turbines and possibly some renewable energy resources.[330]
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The hydropower lost from breaching six dams would be replaced with non-hydro power generation, most likely combustion turbines (CT) and possibly with cost-competitive renewable resources. For example, breaching the John Day Dam and the four lower Snake River dams and operating at a "natural river" level would decrease generating capacity by about 2,000 aMW.[331] Under this Policy Direction, generation would be further decreased by the breaching the McNary Dam. The considerable loss of hydropower would result in a much greater and immediate need for replacement power than under Status Quo. Although some of the power loss would likely be accommodated by energy conservation and renewable resources, most of the need for power production would be met by CTs. There would be a much greater need for new resources than under Status Quo.
Weak Stock Focus	The effects from breaching dams would be similar to those under Natural Focus, but would occur to a lesser degree because only the four lower Snake River Dams are breached. Any additional constraints put on power generation at existing facilities for listed stocks (e.g., changes in flow, spill, drawdowns, and facility modifications to improve in-river juvenile salmon survival) would further reduce available generation. As under Natural Focus, the lost hydropower would likely be replaced by combustion turbines, conservation, and, possibly, renewable resources. As an

[325] Corps 2002b, Section 4.10.1 Generation**.**

[326] USDOE/BPA 2002a.

[327] See Chapter 2, Section 2.3.2.3 Conflicting Policies: Managing the Money Resource

[328] Data taken from US Census Bureau, http://www.census.gov (last visited February, 2003).

[329] USDOE/BPA 2000c, p. 63.

[330] See Appendix E of this EIS.

[331] The 2000 aMW is drawn from the Corps' John Day Drawdown Phase I Study (Corps 2000) Section 10.4.6.2 (1,146 aMW), and the Lower Snake River FEIS/Final Report (Corps 2002b), Table 5.10-2 (820-960 aMW).

EFFECT AREA: COMMERCIAL INTERESTS: Power less need for new resources = better	
	example, the hydro power lost over the next 10-20 years from removal of the four lower Snake River Dams would reduce BPA firm sales by about 800-1000 aMW.[332] That would mean lost ability to meet customers' loads and historical obligations. The amount of additional lost hydropower from extra constraints would depend on the severity of the restrictions. Overall, the need for immediate replacement power from new resources would be much greater than under Status Quo.
Sustainable Use Focus	Modifications to the hydrosystem at existing facilities to benefit fish would be balanced with the need for reliable generation within the Region. Many improvements for fish would be structural or technological improvements that would have little effect on generation. Depending on the specific improvement (e.g., use of flow, spill, and peak efficiency turbine operations), this Policy Direction could possibly result in some small decreases in hydrosystem generation with little, if any, changes expected to the transmission system or ancillary services. Efforts benefiting fish while allowing for increased generation would be achieved through actions such as increased fish transportation. Overall, such changes would result in a small change in the amount of hydropower generation available over the next 10-20 years.[333] Compared to Status Quo, there would likely be no additional need for replacement power.
Strong Stock Focus	Hydropower operations would be managed to protect existing strong stock habitat, water quality, and instream flows. Restrictions on hydropower operations would likely decrease where they are constrained by weak-stock management, allowing for more generation. Overall, there would be less need for new resources compared to Status Quo.
Commerce Focus	The laws of supply and demand would have more influence on the amounts and mixes of power generation. Restrictions on hydrosystem operations would decrease to support economic growth.[334] Flow augmentation and spill would be reduced in order to store water for increased power generation when power is more valuable. Overall, the need for new generation would decrease.

EFFECT AREA: COMMERCIAL INTERESTS: Transmission fewer impacts = better	
Existing Conditions	BPA owns and operates more than 15, circuit-miles of high-voltage line (or about three-fourths of the bulk transmission in the Northwest), including transmission facilities that provide power to and from other regions, such as California and Canada. This transmission system serves as the connection for the 31 Federal hydro projects and numerous other generating facilities, and as the importer/exporter of power among several regions.[335] Ancillary services for the overall power system (transmission and generation) are also important. For example, hydropower generation can be quickly adjusted up or down as an automatic generation control (AGC) provides the required frequencies in the transmission system. The

[332] Corps 2002b, Section 5.10.1.2 Power System Models.

[333] Corps 2002b, Section 5.10.2.2 Alternative 2—Maximum Transport of Juvenile Salmon; and Table 5.10-2. Also, USDOE/BPA 2000d.

[334] Council 2000a, Framework Alternative 7.

[335] USDOE/BPA 2002a.

EFFECT AREA: COMMERCIAL INTERESTS: Transmission fewer impacts = better	
	hydropower units may also be operated as a motor, in a condensing mode, to balance the needs of the transmission system.[336] Habitat actions, including avian protection activities, can limit maintenance (e.g., vegetation removal, pesticide use), causing transmission costs to increase. Decreased road densities that affect access to transmission facilities can increase the time required for maintenance activities, also causing transmission costs to increase and reliability to decrease.[337] Increasing population growth is stressing the existing transmission system and major infrastructure investments are underway.
POLICY DIRECTION	
Status Quo	Continual modifications to dams and changes in operations will reduce generation or alter the timing of generation affecting transmission requirements—placing stress on system reliability. The Pacific Northwest transmission grid was originally constructed to complement the generation system. Because the transmission and generation systems interact electrically, the loss of hydropower generation will affect the transmission system's ability to move bulk power and serve regional loads.[338] Transmission facilities will be affected by large shifts in the location of generation capacity. Reduced voltage support from these generators and transmission capacity reductions caused by the loss of generation will likely require additional transmission facilities. Some habitat actions and avian protection activities will change the transmission construction and maintenance activities near certain habitat and avian concentration areas. For example, if manual methods were used for vegetation management on the rights-of-way to protect habitat, more frequent maintenance cutting will be required, increasing the human presence and animal disturbance, as well as increasing maintenance costs.[339] Overall, there will be some increase in the need for new transmission facilities[340] in response to population growth, transmission congestion, and an increased need for power of about 2,400 aMW (see Power, above).
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam removal would affect the reliability of the transmission system. Transmission facilities are impacted by large shifts in the location of generation capacity. For example, the loss of about 2,000 aMW[341] from breaching the four lower Snake River dams and the John Day Dam would reduce voltage support from these generators and cause transmission capacity reductions, likely requiring additional transmission facilities.[342] The increase in annual transmission reliability costs from the drawdown of both the Snake River dams and John Day reservoir would be between about $24 million and $37 million.[343] These costs would increase further if McNary Dam were breached. New generation would likely be needed to

[336] Corps 2002b, Section 4.10.3.4 Daily Generation and Ancillary Services.

[337] See Chapter 5, Section 5.2.3.2 Economic Environment.

[338] Corps 2002b, Section 5.10.1.3 Transmission Reliability.

[339] USDOE/BPA 2000a, Chapter VI Environmental Consequences, Threatened and Endangered (T&E) Species section, and Chapter II Methods, Cost section.

[340] USDOE/BPA 2001a, Executive Summary.

[341] Corps 2000, Section 10.4.6.2 Social Effects by Area of Impact: Power.

[342] Corps 2000, Sections 4.11 Hydropower Operation and 7.10.1 System Transmission Effects.

[343] Corps 2000, Section 10.2.2.3 System Transmission Effects.

EFFECT AREA: COMMERCIAL INTERESTS: Transmission fewer impacts = better	
	compensate for the lost hydro generation, requiring additional transmission facilities. If the new generation facility were strategically located, however, it could defer some load service transmission that might otherwise be needed.[344] In addition to being costly, many ancillary services (e.g., AGC and emergency reserve power) necessary for a safe and reliable power system could be lost. The total ancillary economic effect is estimated at more than $20 million.[345] Overall, there would be many more impacts to transmission resulting in conditions that are much worse compared to Status Quo.
Weak Stock Focus	The effects would be the same as those under Natural Focus, except that the extent of impacts affecting transmission facilities would be less. For example, breaching the four lower Snake River dams would reduce hydropower generation by approximately 800-1000 aMW.[346] The transmission reliability costs are estimated at about $25 million, and the ancillary service costs around $8 million.[347] There might be additional changes to the power system to protect and enhance listed fish and wildlife species habitat; those changes could further reduce generation capabilities and affect development and maintenance of transmission facilities or ancillary services. The impacts to transmission would be worse than compared to Status Quo.
Sustainable Use Focus	Transmission could be affected by modifications to existing hydro generation facilities to balance benefits between fish and wildlife and reliable generation and transmission. It is likely that balancing these two aspects would keep the hydro changes within the region's ability to continue to benefit from the existing transmission facilities over the next 10-20 years.[348] No additional transmission construction or changes to maintenance practices would be needed than what is projected under Status Quo. Overall, transmission impacts would be about the same as those under Status Quo.
Strong Stock Focus	Fewer restrictions on hydropower operations for weak stocks would result in fewer impacts to the transmission system. Some planned system modifications could be deferred. Transmission system maintenance would avoid, minimize, or mitigate its effects on strong stock/population habitat. Compared to Status Quo, there would be fewer impacts to transmission.
Commerce Focus	The same economic factors that affect hydropower generation would apply to the transmission system. Emphasis would be placed on increasing system reliability. For-profit development of transmission systems would be introduced. Maintenance would increase resulting in higher transmission reliability. Some planned transmission system upgrades and expansions could be deferred because the existing system would be more reliable than it would be under Status Quo. However, new development may result in the need for transmission construction. Overall, there would be fewer impacts to transmission than compared to Status Quo.

[344] Corps 2002, Section 5.10.1.3 Transmission Reliability; Chapter 5 of this EIS, Section 5.2.3.2 Economic Environment.

[345] Corps 2000, Sections 10.2.2.4 Ancillary Services Effects and 10.2.2.5 Summary of Hydropower Net Economic Effects.

[346] Corps 2002b, Section 5.10.1.3 Transmission Reliability and Table 5.10-2.

[347] Corps 2002b, Section 5.10.2.3 Alternative 4—Dam Breaching.

[348] Corps 2002b, Section 5.10.2.2 Alternative 2—Maximum Transport of Juvenile Salmon and Alternative 3—Major System Improvements.

EFFECT AREA: COMMERCIAL INTERESTS: Transportation fewer impacts = better	
Existing Conditions	Major modes of commercial transportation for the region include rail, trucking, and navigation. The Columbia and Snake Rivers provide a major water transportation route; the Region also has extensive road and rail transportation corridors. The main impacts to transportation/navigation from fish and wildlife activites primarily affect commercial transporation that uses the major river systems. The 465-mile Columbia-Snake Inland Waterway represents a key link to the Columbia-Snake River Basin interior region, facilitating navigation from the Pacific Ocean to inland ports as far away as Lewiston, Idaho. This transportation system consists of navigation channels and locks, port facilities, and shipping operations. The system is used to ship commodities in and out of the Pacific Northwest. The navigation system consists of two segments: the downriver portion, which provides a deep-draft shipping channel, and the upriver portion, which is a shallow-draft channel with a series of navigation locks. The Corps maintains a navigation channel 250 feet wide and 14 feet deep from the mouth of the Snake to the the confluence of the Clearwater and Snake Rivers. This channel connects the interior section of the Basin with the lower Columbia River deep water ports. The products shipped through the system include grain, wood chips, logs, wood products, petroleum products, farm products, chemicals, sand and gravel, automobiles, and containerized products.[349] Fifty-four port and other shipping operations provide transportation facilities for products. In an average year, roughly 8-10 million tons of commodities are shipped through the navigation lock at the John Day Dam.[350] The total traffic passing through the Ice Harbor lock was 3.6 million tons in 1996.[351]
POLICY DIRECTION	
Status Quo	The mode of transportation most impacted by fish and wildlife activities is navigation, especially the shallow-draft portion of the Columbia-Snake Inland Waterway and lower Snake River system. Total barged tonnage through John Day Dam and the lower Snake River dams is expected to grow from 11.3 million tons in 2002 to 13.3 million tons in 2022.[352] The Corps continues to maintain the shallow-draft portion of the channel. Rail and road traffic will continue to increase as the economy in the Region grows.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam breaching would curtail navigation for commercial vessels and divert commerce to trucks and trains. For example, breaching the John Day Dam and the lower Snake River dams would require substantial changes to barging and fleets and substantially decrease commerce for the ports, related businesses, and barge lines.[353] The average annual cost of shipping Columbia and Snake River goods would increase from about $80 million to $100 million per year.[354] "Port and farm communities, navigation laborers and operators, and other indirectly affected interests may not be covered by these loss estimates."[355] The projected cost of

[349] Corps 2002b, Sections 4.9 Transportation, 4.9.1.2 Ports and 4.9.1.4 Commodity Movements.

[350] Corps 2000, Section 10.2.4 Navigation NED Evaluation.

[351] Corps 2002b, Section 5.9.1.1 Methodology.

[352] Corps 2000, Section 10.2.4.3 Commodity Projections.

[353] Corps 2000, Sections 7.9 Navigation Impacts and 9.4 Navigation Modifications.

[354] Corps 2000, Section 10.2.4.4 Costs of Drawdown Alternatives.

[355] Cost estimates are from Corps 2002b.

EFFECT AREA: COMMERCIAL INTERESTS: Transportation fewer impacts = better	
	upgrading the railroad and highway transportation system is in excess of $200 million.[356] In addition, railroad and highway embankments are located in vulnerable areas where wave impingement, undercutting, erosion, rapid dewatering, and ultimately failure are likely to occur. Consequently, adjacent transportation routes might experience varying degrees of track misalignment and effects on roads that might experience movement, cracking, slumping, piping, and other failures.[357] Future flood events could cause damage to portions of the railroad and highway system. There would be increased truck and rail transportation, mainly caused by loss of barging. The effects of this Policy Direction would be much worse for transportation than those under Status Quo.
Weak Stock Focus	The effects would be the same as those under Natural Focus; however, the extent of impact would be less because no mainstem dams would be breached.[358] For example, it is projected that breaching the four lower Snake River dams and changing from barging to trains and trucks would increase annual average transportation costs from about $28 million to about $48 million. Congestion and wear on road and rail infrastructure would also increase.[359] It is estimated that breaching the four lower Snake River dams would divert barged grain to railroads (about 30%) and highways (about 70%) for transport. Both of these shifts would require investments in the infrastructure for railroads and highways. The projected costs of upgrading the transportation system is in excess of $100 million.[360] Overall, the effects on transportation would be worse than those under Status Quo.
Sustainable Use Focus	Navigation could be affected by changes made to hydro facilities and operations for fish enhancements; however, any impacts are likely to be small. Navigation could also be improved through practices such as channel deepening, as long as it is balanced with fish and wildlife needs. Any reduction in navigation would result in a small increase in the use of rail and road transportation.[361] There might be some small increases in other transportation costs if there are modifications to the hydro system for fish and wildlife. The modes of transportation for goods are not likely to change any more than under Status Quo. Impacts to transportation from fish and wildlife activities will be the same as those under Status Quo.
Strong Stock Focus	A shift to strong stock management would result in a decrease in impacts to navigation. In particular, the river transportation system would see little impact because changes to hydropower operations would be minimal. In fact, navigation could improve through practices including channel deepening, as long as strong stocks are not impacted. The terrestrial transportation system would remain largely unchanged; however, adjustments in road densities and locations would be made to benefit healthy stocks of fish and wildlife. For example, new development in

[356] Corps 2000, Section 10.2.8 NED Cost Summary, Table 87.

[357] Corps 2000, Section 7.8.1 Transportation; and Corps 2002b, Section 5.2 Geology and Soils.

[358] Corps 1999a. The Drawdown Regional Economic Workgroup (DREW) Transportation Workgroup conducted a transportation analysis as part of the Corps' Lower Snake River Juvenile Salmon Migration Feasibility Study EIS in order to identify and quantify the direct economic effects resulting from disruption of the existing transportation system. This analysis was designed to measure the effect of breaching the four Lower Snake River dams on the costs of transporting products that are currently shipped on the Columbia-Snake River Inland Waterway.

[359] Corps 2002b, Section 5.9.4 Summary of Transportation-Related Economic Effects.

[360] Corps 2002b, Section 5.9 Transportation and Table 5.9-1.

[361] Corps 2002b, Section 5.9 Transportation.

EFFECT AREA: COMMERCIAL INTERESTS: Transportation fewer impacts = better	
	riparian areas would be limited and system expansion in strong stock watersheds would be constrained. Transportation would likely be better than compared to Status Quo.
Commerce Focus	Market forces, rather than hydrosystem operation or the presence of dams and other water management facilities, would decide the future of river-based transportation. The proportion of modes of transportation used (navigation, rail, road) would continue to be based on cost. River transportation would benefit somewhat from less-restricted hydro operations, more efficient navigation lock operations, and improved dredging (including channel deepening). Terrestrial transportation would reflect changes in the river system's use. Increased economic development could lead to more investments in rail and road transportation, especially for transporting goods in areas removed from the Waterway. Overall, there would be fewer impacts to transportation than compared to Status Quo.

EFFECT AREA: COMMERCIAL INTERESTS: Agriculture, Ranching, and Forest Products fewer impacts = better	
Existing Conditions	Agriculture, ranching, and the forest products industry can be impacted by fish and wildlife activities, resulting in reductions or changes in farm yield, range production, and timber harvest. These impacts are related to restrictions in land and water use, and increased regulation on Federal lands to protect listed species and ecosystem health. Agriculture includes irrigated and non-irrigated crop land, hayland, and seeded pasture. There are approximatley 7 to 9 million acres of irrigated agriculture in the Columbia River Basin. Some agriculture is dependant on irrigation water from Federal facilities. The Columbia River Basin also supports approximately 16 million acres of non-irrigated lands, 45 million acres of rangeland (of which approximately 25 million acres are on Federal property), and 65 million acres of forested lands (42 million acres on Federal property). Irrigated agriculture includes pasture, hay, small grains, corn, potatoes, apples, and relatively small acreage of many other crops, fruits and vegetables.[362] Rangeland accounts for about 33% of the land cover in the interior Columbia Basin.[363] Most grazing use in the Northwest is for cattle, although some is for sheep and horses. Forests are the predominant land cover in the Pacific Northwest, accounting for almost one-half.[364] In 1994, timber-based industries (paper mills, sawmills, logging, and wood products) were the second largest source of direct, indirect, and induced employment in the upriver subregion, accounting for 21% of total employment.[365] Between 1990 and 2000, the Region experienced growth in human population of about 21%.[366] However, demand for agricultural and forest products is not directly correlated to regional population growth. Commodity prices are set in national or international markets, so producers cannot pass most agricultural, range, or forest production costs on to consumers.

[362] Corps 2002b, Table 4.11-2 Acreage and Crops Grown on Farms Irrigated From Ice Harbor Reservoir.

[363] Quigley and Arbelbide 1997, p. 458.

[364] Quigley and Arbelbide 1997, p. 458.

[365] Corps 2002b, Section 4.14.1.1 Employment.

[366] Data taken from US Census Bureau, http://www.census.gov (last visited February, 2003).

EFFECT AREA: COMMERCIAL INTERESTS: Agriculture, Ranching, and Forest Products fewer impacts = better	
POLICY DIRECTION	
Status Quo	The U.S. Census Bureau projects that the Region's population will grow about 19% between 2000 and 2015.[367] Overall, there will be a gradual increase in impacts to farming, ranching, and timber harvest as activities taken to benefit fish and wildlife increase. USDA's land conservation programs provide positive incentives for changing to uses and practices that favor fish and wildlife on private farmland and rangeland. There are some restrictions to benefit protected species that impact the agricultural managers' ability to enter into agreements for renewable energy development. Rangeland grazing is declining, especially on Federal land, in response to government decisions about carrying capacity and resource protection, and in response to the business or personal decisions.[368] The projected decline is attributed to stocking rate reductions in recognition of continuing resource damage and declining economic feasibility of livestock grazing, as well as to recovery plans for federally-listed threatened and endangered species. Timber harvest from the interior Columbia Basin accounts for about 10% of the total U.S. harvest.[369] The amount of annual timber harvest is declining, especially on Federal land.[370] Although demand for forest products is expected to increase, per-capita consumption will decline slightly.[371] Timber harvesting costs are increasing, as methods and prescriptions for addressing increasingly complex fish and wildlife habitat goals are incorporated.[372] As habitat-based restrictions on solid wood supply increase, the type and quality of natural resource products are shifting, with increasing reliance on engineered, reconstituted, and recycled products.[373]
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The breaching of six dams and drawdown of reservoirs would severely restrict water withdrawals, especially irrigation, in those areas. At John Day Reservoir alone, there are 30 irrigation pump stations and approximately 180,000 acres of irrigated lands.[374] Consequently, under dam breaching conditions, most operators would no longer be able to pump water from the reservoir, agricultural production would drop, and the value of much of the affected farmland could be reduced to the value of non-irrigated rangeland, less than half the current land value (not including on-farm or other irrigation system modification costs).[375] Breaching of the dams would allow large volumes of sediment to be carried downstream. These induced sediment deposits could present problems with existing water withdrawal intakes for agriculture downstream. Agricultural land use practices would be substantially

[367] Data taken from US Census Bureau, http://www.census.gov (last visited February, 2003).

[368] USDOI 1994.

[369] USDOI 1994, p. 86.

[370] Quigley and Arbelbide 1997, p. 86.

[371] Quigley and Arbelbide 1997, p. 1790.

[372] Quigley and Arbelbide 1997, p. 1798.

[373] Quigley and Arbelbide 1997, p. 1798.

[374] Corps 2000, Section 4.13 Irrigation, p. 24.

[375] Corps 2000, Sections 7.12 Irrigation Impacts and 10.2.5 Water Supply and Irrigation NED Evaluation; Corps 2002b, Sections 5.12.1.2 Alternative 4—Dam Breaching, Transportation and 5.14.2.1 Lower Snake River Study Area.

EFFECT AREA: COMMERCIAL INTERESTS: Agriculture, Ranching, and Forest Products fewer impacts = better	
	modified. The costs of services to agricultural and forest products operations, and inputs such as transportation and electricity, would increase. For example, transportation costs to move goods to market would increase because navigation would be reduced. Agricultural production would drop, and the value of the farmland would likely be reduced. Much of the farm, range, and timberland use would be prohibited in and adjacent to the breached dams and in the areas where human use is restricted to protect habitat. Further, grazing and timber harvest on public lands with high habitat value would be virtually eliminated, as habitat is protected. Commercial forest practices would shift increasingly from public land to private land. Forest management would shift away from management for merchantable products. More old growth timber would be protected. Reductions in forest management activities combined with past wildfire suppression efforts could increase the amount and severity of wildfires, though in the long term a more natural fire-dependant ecosystem would develop. Overall, this alternative would be much worse for agriculture, ranching, and forest products than under Status Quo.
Weak Stock Focus	Breaching dams and drawing down reservoirs would have similar effects as those discussed in Natural Focus, though the amount of impacts would be less. For example, water supplied by the Ice Harbor reservoir for 37,000 acres of irrigated farmland valued at more than $134 million would be affected. Water pumping would be stopped or have increased costs in the hundreds of millions of dollars, agricultural production would drop, and the value of the farmland would likely be reduced.[376] Loss of land value could lead to a decreased county property tax base in many regional counties.[377] Agriculture, ranching, and forest operations would be limited as more habitat would be enhanced for listed wildlife and fish. For example, ecosystem enhancement activities could cause significant changes in agriculture, range, and forestland management. Restricted timber harvest due to fish and wildlife activities could result in less marketable timber (low-value, small-diameter logs) requiring increased subsidies. However, large areas of potential range and forest land would be exposed—approximately 14,000 acres for the four lower Snake reservoirs alone.[378] Overall, this alternative would be worse for agriculture, ranching, and forest products compared to Status Quo.
Sustainable Use Focus	Agriculture, grazing, and forestry could be impacted as fish and wildlife mitigation and enhancement activities increase, forcing these industries to focus on increasing production efficiency, or adjusting operations. Intensive cultivation, selective grazing, and innovative forest management practices could mitigate most impacts. Multiple-use management would allow for both commodity production and benefits for fish and wildlife. For example, increasing restrictions on livestock grazing to address habitat goals could be used to produce a shift to more efficient land uses (such as cattle grazing in young timber stands) to reduce fine fuels, increase the biomass and value of stumpage, and provide income from grazing.[379] Some land retirement could be used where it would benefit fish and wildlife. Overall, the

[376] Corps 2002b, Sections 5.12.1.2 Alternative 4—Dam Breaching, Transportation and 5.14.2.1 Lower Snake River Study Area.

[377] Corps 2002b, Sections 5.12.1.2 Alternative 4—Dam Breaching, Transportation and 5.14.2.1 Lower Snake River Study Area.

[378] Corps 2002b, Summary p. 35.

[379] USDA/USFS and USDOI/BLM 1997, p. 1798.

EFFECT AREA: COMMERCIAL INTERESTS: Agriculture, Ranching, and Forest Products fewer impacts = better	
	effects of this Policy Direction on agriculture, ranching, and forest products would be similar to those under Status Quo.
Strong Stock Focus	The use of irrigated agriculture would increase as restrictions on water use relaxed and efforts to increase instream flows for weak stocks declined. Actions to acquire additional water rights for improving weak-stock habitats—rights that compete with irrigation demands—would be eliminated. New agricultural development, ranching and grazing operations and practices could be constrained near healthy stock habitat. Previously focused on management for listed species, there would be an expansion of other uses such as grazing and timber harvests in these areas. The mix and yield of forest products could shift commensurate with the shift in management emphasis. Overall, the effects of this Policy Direction would be better than Status Quo.
Commerce Focus	Existing, cost-effective agricultural irrigation would be maintained, and other uses of Columbia Basin water would increase with increased development. Dryland and irrigated farming could increase based on the value of the crop. The impacts of management changes on farmers and landowners would depend on the mix of positive economic incentives. Increased development could result in agricultural lands being taken out of production and sold for higher value uses. Less land would be set aside for fish and wildlife resulting in more available land for other uses such as grazing and forest products. Overall, agricultural, ranching, and forest products would be better than Status Quo under this alternative.

EFFECT AREA: COMMERCIAL INTERESTS: Commercial Fish Harvest more harvest = better	
Existing Conditions	Impacts to commercial fish harvest from fish and wildlife activities are closely related to the harvest levels set for specific stocks of anadromous fish. Columbia Basin salmon are harvested both in-river and off the coast of the northwestern U.S., Canada, and Alaska. Overall, the salmon fishery can be defined as a mixed-stock fishery, with increases in harvest levels only when abundance is high. Hatcheries have been operated to support anadromous fish populations for harvest. Ocean fisheries are very difficult to manage: the life history of salmon (e.g., migratory patterns and natural population levels); multiple jurisdictions, laws, and treaties involved; and the natural mixing of salmon populations from different freshwater origins all need to be considered.[380] The freshwater commercial fishery of the Columbia River system includes in-river sport charter boats, the non-Indian gillnet fishery (operating in the zone from the estuary to Bonneville Dam), and the treaty Indian gillnet fishery (operating in the mainstem Columbia River between Bonneville Dam and McNary Dam).[381] While in the river, the fishery is subject to Federal, state and tribal jurisdictions, laws (e.g., ESA), treaties, and management strategies. Harvest seasons and catch have been reduced compared to historical conditions. For example, the commercial and sport harvest of chinook salmon off the Washington and northern Oregon coasts has declined from nearly 600,000 fish in 1974 to an average of about 15,000 fish since 1994.[382] There also have been similar declines evidenced in the commercial river harvest.[383] The general decline of

[380] Federal Caucus 1999b, Harvest Appendix, p. 6.

[381] Federal Caucus 1999b, Harvest Appendix p. 5.

[382] Federal Caucus 1999b, Harvest Appendix, p. 8.

[383] Federal Caucus 1999b, Harvest Appendix, p. 8.

EFFECT AREA: COMMERCIAL INTERESTS: Commercial Fish Harvest more harvest = better	
	salmon stocks resulted in no commercial in-river spring chinook fishery since 1977. There has also not been an official commercial fishery for summer chinook since 1967, although summer chinook were incidentally harvested during the sockeye salmon harvest until about 1973.[384] Changes in harvest regulations have been in the form of restrictions, shortened seasons, area closures, special gear regulations, license moratoria, and buyouts of fishing fleets. There has been a trend to reduce harvest rates in mixed-stock areas in favor of harvests in more terminal areas where the stocks can be segregated and more selectively caught.[385] In 1999, the United States and Canada signed the Pacific Salmon Treaty, focusing on a cooperative, conservation-based approach that results in more equitable sharing of salmon catches between Canada and the United States.[386]
POLICY DIRECTION	
Status Quo	The Pacific coast fisheries south of the Canadian border, directed primarily at chinook and coho salmon, recently reported harvests of chinook salmon that increased with increased abundance. For example, in 2000 the Oregon ocean chinook harvest was 135,900 fish, while in 2001 the preliminary numbers estimated the harvest at 275,000 fish.[387] Also, in 2000 the Columbia River in-river, treaty Indian, and sport commercial harvest of up-river adult spring chinook was a little more than 90 fish, but in 2001 the harvest was 22,689 fish. This sudden improvement may be related to improved ocean conditions and the future trend is difficult to predict. ESA obligations have resulted in increased emphasis on protecting threatened or endangered native fish. Reduction in harvest has reduced the economic benefits to local communities, industries, and gear manufacturers, among others. Harvest may be further reduced to comply with planned ESA and Pacific Salmon Treaty actions. The commercial salmon fishery has recently been subject to intense economic competition from the salmon aquaculture industry. Most farm-raised salmon come from Canada, Europe and South America. Economic trends and pressure from more costly harvest regulations are expected to result in continuing declines in the amount of commercial salmon fishing and the economic value of salmon harvest.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Most ocean and Columbia Basin harvest would be decreased substantially or eliminated, at least for the short term. Also, the elimination of hatchery production would further decrease harvest opportunities. Remaining opportunities would focus on the targeted harvest of selected stocks, primarily in tributaries. The short-term adverse effects from the removal of six dams would further decrease the number of fish available for harvest. As naturally-spawning anadromous fish increase in the log term, more harvest would be allowed. Overall, commercial fishing would be much worse than under Status Quo.
Weak Stock Focus	Further protections of weak stocks and a shift in hatchery management to emphasize the conservation of weak stocks would result in a decrease in harvest. The removal of the four dams would adversely affect anadromous fish in the short term, limiting the number of fish available for harvest. The change in hatchery management would

[384] Federal Caucus 1999b, Harvest Appendix, p. 8.

[385] Federal Caucus 1999b, Harvest Appendix, p. 7.

[386] Pacific Salmon Commission, The Pacific Salmon Treaty, June 3, 1999.

[387] Pacific Fishery Management Council 2002.

EFFECT AREA: COMMERCIAL INTERESTS: Commercial Fish Harvest more harvest = better	
	result in less harvestable hatchery fish production and contribute to additional restrictions on commercial harvest. There could be an increase in the harvest of weak stocks as they recover. A shift to selective fish harvest would allow some commercial harvest of non-weak stocks to continue. Overall, there would be less commercial harvest compared to Status Quo.
Sustainable Use Focus	The shift to compensation/supplementation hatchery management to produce harvestable hatchery fish would allow for increased commercial harvest. This harvest would include both hatchery-produced and naturally-spawning fish. Habitat would be improved and managed to enhance production of fish and increase harvest. Overall, there would be more commercial harvest compared to Status Quo.
Strong Stock Focus	Commercial harvest would be constrained only if that harvest would result in a decline of self-sustaining populations of healthy stocks. There would be no harvest restrictions placed on weak stocks. Habitat management efforts and increased hatchery production would allow for increased harvest. Overall, the commercial fishery harvest would increase relative to Status Quo.
Commerce Focus	Losses of fish production from upstream areas would be offset by increases in the amounts and efficiencies of hatchery-produced marketable fish, and by increases in fish farm production in the lower river and estuary. A selective fish harvest could increase when economically efficient. With fish farming and more hatchery production, the commercial fish harvest would increase compared to conditions under Status Quo.

EFFECT AREA: COMMERCIAL INTERESTS: Other Industry fewer impacts = better	
Existing Conditions	The regional economy has experienced some transition over the last decade or so, evolving from being primarily natural resource-based to a diverse economy with growing trade and service sectors. The largest industry sectors (and their relative contributions to the regional employment) include services (25.0%); trade (21.1%); government (16.4%); manufacturing (11.7%); fire, insurance and real estate (6.0%); and construction (4.7%).[388] Of these sectors, services has shown the highest economic growth, and has the highest per-capita income. Economic activity is greatest in metropolitan areas, but distribution varies by sector. Some economists believe that areas with high amenity values (i.e., public lands) tend to attract new businesses and skilled labor.[389] Mining provides about 0.5% of regional employment. Mining, aluminum products, and other natural resource-based and water- and energy-dependent industries are facing increasing regulation, operational costs, and foreign competition. These factors have resulted in a general decline of these industries. In contrast, services and government sectors are increasing.
POLICY DIRECTION	
Status Quo	The regional economy will continue to grow and diversify as the human population increases. The population in the Region is projected to grow about 19% between 2000 and 2015.[390] Information-based technologies and services are expected to

[388] USDA/USFS and USDOI/BLM 1997, p. 1732.

[389] USDA/USFS and USDOI/BLM 1997, p. 1735.

[390] Data taken from US Census Bureau, http://www.census.gov/population/projections/state/stpjpop.txt (last visited February, 2003).

EFFECT AREA: COMMERCIAL INTERESTS: Other Industry fewer impacts = better	
	grow fastest, followed by trade, government, and manufacturing.[391] Natural resource-dependent industries will continue to face increasing costs and foreign competition. Growth in the natural resource industries will likely decline. For example, a shrinking road network on Federal lands adversely affects mining. The aluminum industry is severely affected by the price of electricity, world supply, and foreign competition. These trends are expected to continue.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Many existing industries, especially aluminum, would be severely affected by increased power costs as a result of the need to purchase replacement power to compensate for breaching dams. Other industries would be affected by the loss of navigation (see Transportation) and water withdrawals due to dam breaching. Industries would be restricted from locating in rural and wildland areas. Restricted access to protected areas would result in the further decline of natural resource-based industries, such as industrial mineral mining (e.g., sand and gravel). Overall, the effects on industries would be much worse compared to Status Quo.
Weak Stock Focus	Many existing industries would be impacted by increased power and transportation costs and reduced water withdrawals as a result of dam breaching, similar to Natural Focus. Development would also be restricted in weak-stock habitat. Further, there would be active remediation of natural resource-based industrial impacts in weak-stock habitats. Environmentally friendly industries and development would be encouraged. Overall impacts, though not as severe as those under Natural Focus, would still be worse compared to Status Quo.
Sustainable Use Focus	There could be some restrictions on certain industries if harvestable levels of fish and wildlife are impacted. These impacts would likely be offset by increases in other industries, such as the services, trade, and government sectors. Active remediation of natural resource-based industrial impacts would be required. Overall, impacts to other industry would be about the same as compared to Status Quo.
Strong Stock Focus	A decrease in development restrictions would allow increases in industrial activity. These increases would only be limited in areas where strong stocks could be adversely affected. Industries could benefit from more affordable power and transportation. Overall, there would be fewer impacts on other industries compared to Status Quo.
Commerce Focus	Regulatory flexibility and positive incentives would allow industry expand while still fulfilling environmental responsibilities. River management would not be restricted by costly weak-stock management and would be increasingly tailored to needs of all of its multiple uses, including navigation, power production, and consumptive water uses. Overall, other industry would be much better than compared to Status Quo.

EFFECT AREA: RECREATION: Sport Fishing and Wildlife Harvest more opportunities = better	
Existing Conditions	Impacts to sport fishing and hunting (including trapping) are areas of concern related to fish and wildlife populations and policies. Throughout the region, recreational fishing and hunting industries are centered on rivers, reservoirs, and forested and other undeveloped lands. The Region has plentiful hunting/trapping opportunities, such as big game (e.g., deer and elk), upland game (e.g., pheasants and rabbits),

[391] USDA/USFS and USDOI/BLM 1997, p. 1743.

EFFECT AREA: RECREATION: Sport Fishing and Wildlife Harvest more opportunities = better	
	furbearers (e.g., beaver and mink), and waterfowl (e.g., ducks and geese). Recreational fishing for resident fish (e.g., trout and bass) and anadromous fish (e.g., salmon and steelhead) is also plentiful. For many years, the fisheries have been supported by hatchery production to help maintain harvest levels. For the past decade hundreds of thousands of hunters and anglers have spent millions of dollars annually in support of these recreational activities.[392]
POLICY DIRECTION	
Status Quo	Sport fishing and hunting would continue at levels similar to existing conditions. In 1999, the Columbia River Basin hatcheries produced more than 140 million anadromous fish to help supplement the fisheries.[393] Some ESA listings may have reduced economic benefits to local communities, tourism industries, gear manufacturers, guides, etc. Even in light of these listings, recreational fishing and hunting still produce a sizable economic benefit. For example, in 2000, Oregon and Washington combined sold more than 1.5 million fishing licenses and more than half a million hunting licenses. This amounted to about $17 million in license revenues for fishing and more than $11 million for hunting in Oregon alone.[394]
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Closing all hatcheries, decreasing harvest, and reducing some resident and anadromous fisheries would result in a loss of recreational fishing opportunities. Sport fishing during the years immediately after breaching would be reduced because the populations and habitat for most resident and anadromous fish would be reduced. In the long-term, however, the anadromous fish populations could recover enough to allow some recreational fishing opportunities.[395] The number of resident fish found in reservoirs would be reduced, while the number of andromous fish could increase. It is estimated that there would be about a one-third reduction in carying capacity of warmwater fish under near-natural river conditions from breaching the four lower Snake River dams. Drawing down the John Day and McNary Dams would also result in the loss of resident fish habitat. Some resident fisheries may be eliminated, while others, such as smallmouth bass and sturgeon, would likely increase in numbers sufficient to permit recreational fishing. Over time, fishing opportunities might increase with increasing fish populations. The increased recreational fishing opportunities were projected to increase the economic value about $14 to $50 million annually.[396] In the short term, dam breaching would also cause some waterfowl areas to be lost, reducing hunting opportunities. However, new habitat would become available over time as a result of dam breaching and land retirement. Any increases in habitat would likely be slow due to

[392] See websites for examples of the number of hunter and sport fishers. Oregon: http://www.dfw.state.or.us/index.html; Washington: http://www.wa.gov/wdfw/huntcorn.htm; Idaho: http://www2.state.id.us/fishgame/ (last visited February, 2003).

[393] NMFS 1999c.

[394] Carter, Christopher 2002; and Heath, Carolyn 2002.

[395] Corps 2000, Section 10.4.6.2 Social Effects by Area of Impact, Recreation.

[396] The increased fishery dollars are taken from adding the $8-45 dollars in the Lower Snake document and $6 million from the John Day document. The other general information is taken from the referenced sections. Corps 2002b, Sections 5.13.3.2 New Recreational Activities and 5.13.5 Economic Effects; and Corps 2000, Sections 10.2.3.4 Future With-Project Recreation Use Drawdown to Natural River Level and 7.17 Aquatic Resource Impacts.

EFFECT AREA: RECREATION: Sport Fishing and Wildlife Harvest more opportunities = better	
	passive restoration. Restricted access would reduce some of the gains. With restriction of human access, closure of hatcheries, and restricted harvest, sport fishing would likely be much worse compared to Status Quo, though wildlife harvest opportunities would only be worse.
Weak Stock Focus	Dam breaching would have similar effects as in Natural Focus and could increase sport fishing and hunting opportunities in the long run. For example, recreational fishing would increase, and result in $8 to $45 million of revenue annually if the four lower Snake River dams are breached.[397] However, restrictions on harvest for listed species would limit opportunities. A shift to conservation hatcheries to assist weak stocks would further reduce the number of harvestable fish. In the short term, dam breaching would also cause some waterfowl areas to be lost, reducing hunting opportunities. Although active habitat protection and enhancement would increase overall fish and wildlife production, harvest opportunities would be reduced to protect listed populations, primarily fish. Most hunting opportunities limited by dam breaching are expected to return to pre-breach levels within 10 years.[398] However, overall sport fishing and wildlife harvest opportunities would be worse compared to conditions under Status Quo.
Sustainable Use Focus	The management of fish and wildlife habitat to improve production would increase fishing and hunting opportunities. Increasing hatchery production would further increase the potential sport fish harvest. The creation of a sustainable resident fishery would likely allow for increased angler opportunities, particularly in blocked areas. The economic benefits, especially to support services, would increase substantially as fish and wildlife are managed for increased harvest. Overall, the sport fishing and wildlife harvest opportunities and associated economic benefits would be better than under Status Quo.
Strong Stock Focus	Recreational harvesting of fish and wildlife would be restricted only when it would result in a decline of self-sustaining populations. Harvest restrictions that benefit weak stocks would be eliminated. Recreational harvesting of fish would be supported by hatchery production. Wildlife harvest could be supported by enhanced game management and stocking programs. Overall, the sport fishing and wildlife harvest opportunities and associated economic benefits would be better than under Status Quo.
Commerce Focus	Increased revenues from new and existing industrial and commercial development would help fund fish and wildlife activities. Increases in hatchery and fish farm production and wildlife stocking programs would allow for increased harvest opportunities. Non-native species would be promoted where there is a harvest demand. Anglers and hunters would pay increased user fees to cover production and other related costs. Some fish and wildlife habitat would be managed to preserve hunting and fishing opportunities. Overall, sport fishing and hunting opportunities would be better than under Status Quo.

EFFECT AREA: RECREATION: Other Recreation more opportunities = better	
Existing Conditions	Other recreation (other than fishing and hunting) that are affected by fish and wildlife activities include water-based recreational activities, such as rafting, kayaking, canoeing, water-skiing, boating, windsurfing, swimming. Many boat

[397] Corps 2002b, Sections 5.13.3.2 New Recreational Activities and 5.13.5 Economic Effects.

[398] Corps 2002b, Sections 5.13.3.2 New Recreational Activities, Table 5.13-7.

EFFECT AREA: RECREATION: Other Recreation more opportunities = better	
	launch ramps, beaches, marinas, and other facilities have been developed to support these activities. For example, there are 33 developed recreation sites on the lower Snake River reservoirs alone. These sites include 29 boat ramps with 59 launch lanes, 9 campgrounds with approximately 435 individual campsites, and 49 day-use facilities (e.g., shelters, swimming beaches, and scenic views). There are also 22 access or primitive recreation areas where camping is allowed. More than 25 million people visited the John Day reservoir during a 10-year period from 1989 through 1998.[399] In 1998, the lower Snake River area at the Lower Granite Dam Reservoir had more than one million visitors. Even the the least-visited reservoir behind Lower Monumental Dam had more than 157,000 visitors.[400] Land-based activities such as picnicking, camping, mounatain biking, horseback riding, wildlife viewing, hiking, rock climbing, skiing, and ecotourism are also popular throughout the Region.[401] Many of these recreation opportunities are located in rural areas removed from population centers.[402] The population in the Region grew about 21% between 1990 and 2000, creating more demand for recreational resources.
POLICY DIRECTION	
Status Quo	The population in the Region is projected to grow about 19% between 2000 and 2015.[403] This growth will bring continued pressure for increased recreational resources and ecotourism opportunities. It will also result in a shift away from traditional consumptive uses. Developed recreation is limited in areas where there are listed species of fish and wildlife. Overall, the demand for recreational opportunities is expected to increase as the Region grows.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam breaching would cause the local loss of reservoir recreation; also, the navigation locks would no longer be operational, curtailing navigation for large recreation vessels.[404] In the short term, many recreation jobs and revenues would be lost. For example, breaching the four lower Snake River dams and the John Day Dam would have dramatic effects on regional recreation, reducing by approximately 88,000 acres of surface water area—the supply of lakes and slower moving water that supports flatwater recreation.[405] Lake or flatwater recreation activities, including swimming, water skiing, sailing, windsurfing, and sightseeing in tour boats would no longer be possible. Other activities such as hiking, camping, and wildlife viewing would also be curtailed as access was restricted. Developed recreation would be prohibited in areas that are protected. Recreation activities would change considerably from those under Status Quo, and the number of recreation opportunities would be much less than Status Quo.
Weak Stock	The overall effects from dam breaching would be similar to those from Natural

[399] Corps 2000, Section 10.2.3.2 Existing Recreation Use and Value.

[400] Corps 2002b, Section 4.13.1.2 Visitation**.**

[401] Corps 2002b, Section 4.13.1 Recreation; and Corps 2000b, Section 4.17 Recreation, Table 13.

[402] Corps 2002b Section 2.1.12 Recreation**.**

[403] Data taken from US Census Bureau http://www.census.gov/population/projections/state/stpjpop.txt (last visited 03-14-02).

[404] Corps 2002b, Section 3.4 Alternative 4—Dam Breaching.

[405] Corps 2002b, Section 5.13.3.1 Existing Recreational Activities and Displaced Users; and Corps 2000, Section 4.18.5 General Habitat Description.

EFFECT AREA: RECREATION: Other Recreation more opportunities = better	
Focus	Focus, but access would not be restricted. There would be a shift from flatwater to river-based recreation. For example, breaching the four lower Snake River dams would reduce flatwater recreation area by about 34,000 acres and expose about 14,000 acres of inundated land.[406] Activities such as hiking, camping, and wildlife viewing could still occur in this area along a near-natural area. Some new recreation opportunities (such as drift boating, rafting, kayaking, and jet boating) that require, or are more favorable under, natural or near-natural river conditions would expand.[407] However, weak stock restrictions would further limit recreation. Developed recreation would be further restricted to protect listed species of fish and widlife. Recreation activities would change in some areas from those under Status Quo, and overall other recreation would be worse than Status Quo.
Sustainable Use Focus	Management actions to maintain fish and wildlife populations for harvest would incorporate the need to accommodate other types of recreation. Other recreation would benefit from land acquisitions and management for habitat. Changes in fish and wildlife management could change the types of recreational activities available; however, the amount of recreation should not be affected. Overall, effects from this Policy Direction would be about the same as those under Status Quo.
Strong Stock Focus	There would be somewhat more opportunities for reservoir and river recreation as flow and spill regimes no longer fluctuate erratically for weak-stock management. Developed recreation could increase as long as healthy populations of fish and wildlife are not adversely affected. Other recreation opportunities would increase compared to Status Quo.
Commerce Focus	Fewer restrictions on development would allow for increased developed recreation. Land use may shift if its value for recreation purposes is higher. More water-based recreation would be developed as reservoirs are stabilized and navigation increases. The ecotourism industry would expand resulting in increased demand for other recreation. Some types of recreation would be limited by increased development and crowding. However, in general other recreation would be better than compared to Status Quo.

EFFECT AREA: ECONOMIC DEVELOPMENT: Industrial, Residential, and Commercial Development fewer impacts = better	
Existing Conditions	Impacts to economic development from policies implemented for fish and wildlife activities are concerns for developers. Between 1990 and 2000, the Region experienced about a 21% growth in population.[408] This growth has fueled the development in the industrial, residential, and commercial sectors. The implementation of fish and wildlife policy in the Region has had major effects on three states—Idaho, Oregon, and Washington. These states have had similar experiences with divergent forces affecting urban and rural economies. Major urban areas have undergone significant growth in high-tech industries and corresponding

[406] Corps 2002b, Sections 5.13.3.1 Existing Recreational Activities and Displaced Users, and 5.2 Geology and Soils.

[407] Corps 2002b, Section 5.13.3.1 Existing Recreational Activities and Displaced Users; and Corps 2000, Section 7.16 Recreation Impacts.

[408] Data taken from US Census Bureau, http://www.census.gov (last visited February, 2003).

EFFECT AREA: ECONOMIC DEVELOPMENT: Industrial, Residential, and Commercial Development fewer impacts = better	
	economic development, while rural areas continue to rely on traditional industries experiencing little economic growth.[409] Industrial, residential, and commercial development is largely market-driven, but the concern is how fish and wildlife activities affect local land use plans. For example, the ESA has restricted development in areas with listed species or designated critical habitat. Over the past decade, the uses of habitat conservation plans have become more common.
POLICY DIRECTION	
Status Quo	Industrial, residential, and commercial development is highly market-driven and because the region's population is expected to grow 19% between 2000 and 2015,[410] it is likely there will be continued development Regionwide. However, this development will continue to be restricted based on environmental requirements, such as the ESA. The impacts from fish and wildlife activities tend to felt more by more local and rural communities, which often rely on natural resource-based economies. It is expected that future recovery efforts will continue to affect them disproportionately.[411]
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The development of any industrial, residential, or commercial facilities would be limited in areas exposed by breaching the six dams. There would also be little new development in sensitive areas, such as riparian lands. Development in critical habitat would continue to be prohibited. These effects would be localized, mainly in rural areas. Water supply and power costs to industrial, commercial, and residential customers would increase from lost hydropower (see Power and Ratepayers sections for more details). For example, the economic effects of drawdown and breaching would be most concentrated in the area(s) adjacent to and immediately upriver from the dam(s), primarily agricultural and natural-resource-oriented areas. There would be increased costs for municipal water uses and some industrial water uses. Breaching of the dams would allow large sediment loads to be deposited downstream where they could present problems with existing water withdrawal intakes, including those used for drinking water supply. In general, costs to make the changes have been projected in the range of several hundred million dollars. There would be short-term construction increases connected with the drawdown and other implementing actions for fish and wildlife, such as building replacement power plants. There would also be increased development as the transportation (roads and railroads) infrastructure shifts away from navigation. However, this would likely be offset by the loss of already developed ports. It is also likely that in the short term there would be a decrease in residential development near areas affected by breaching, but in the long term this development may increase, especially along the boundaries of restricted natural areas. Overall, conditions for industrial, residential and commercial development would be much worse than those under Status Quo.
Weak Stock Focus	The effects from dam breaching would be similar to those for Natural Focus, but to a lesser degree. Any industrial, residential, or commercial development adversely affecting listed species would be limited. In addition to land use restrictions, increased costs (e.g., water supply and power) could limit development. For

[409] Corps 2000, Section 10.4.3 Study Area Overview.

[410] Data taken from US Census Bureau, http://www.census.gov (last visited February, 2003).

[411] Corps 2000, Section 10.4.3 Study Area Overview.

EFFECT AREA: ECONOMIC DEVELOPMENT: Industrial, Residential, and Commercial Development fewer impacts = better	
	example, breaching the four lower Snake River dams could increase costs for municipal and industrial water supplies by about $100 million[412] and could increase rates.[413] Overall, there would be more impacts to industrial, residential, and commercial development than under Status Quo.
Sustainable Use Focus	This Policy Direction allows for industrial, residential, and commercial development compatible with fish and wildlife and their habitats. There might be limits on development where it would interfere with rebuilding fish and wildlife populations to sustainable harvest levels. Overall, impacts to development are expected to be about the same as under Status Quo.
Strong Stock Focus	Industrial, residential, and commercial development would increase, mostly as development restrictions for weak stocks were removed and economically costly weak-stock recovery efforts were abandoned. Development would be monitored to ensure that healthy stocks would not be seriously affected. Overall, there would be fewer impacts to industrial, residential, and commercial development compared to Status Quo.
Commerce Focus	Growth would increase as development restrictions for weak stocks were removed and economically costly weak-stock recovery efforts were abandoned. Fewer restrictions on river operations would allow for more hydropower production and less restricted navigation that could potentially stimulate industrial and commercial development. Growth would continue to be limited by land availability, demand, and land use restrictions. Overall, conditions would be better than under Status Quo.

EFFECT AREA: ECONOMIC DEVELOPMENT: Employment more employment = better	
Existing Conditions	Impacts to employment from fish and wildlife mitigation and recovery activities are a Regionwide concern. Total employment in the four-state Region was recently about 5.5 million persons. Services, trade, and government activities accounted for most regional employment and the shares of employment in these sectors have been growing for the last few decades.[414] Generally, the economy of the Basin is evolving away from its dependence on agriculture, range, and timber, toward information-based technologies and services. In 1996, the employment mix in the Region included about 3% farming, 2% forestry/fishing/farm services, 18% construction/manufacturing, and 5% transportation/utilities. In 1997, agriculture, forestry, fisheries, lumber, paper, mining, and electric and gas utilities accounted for less than 10% of employment.[415] Employment in Washington, Oregon, and Idaho increased in all sectors from 1969 to 1998 but the percent relative to the total regional employment declined for farming (from 6% to 3%), manufacturing (from 19% to 12%), and transportation (from 5% to 4%), while it increased from 1% to 2% for agriculture (other than farming), forestry, and fishing. The construction share increased from 5% to 6%.[416]

[412] Corps 2002b, Section 5.11.2.4 Alternative 4—Dam Breaching.

[413] Corps 2002b, Section 5.10.3 Financial Impacts to Ratepayers under Alternative 4—Dam Breaching.

[414] Council 2000a, Section 3.2.4.1 Current Regional Economic Conditions; and USDA/USFS and USDOI/BLM 1997, p. 1734.

[415] Extracted from Council 2000a, Appendix A, Table A-1.

[416] Corps 2002b, Section 4.14.1.1 Employment.

EFFECT AREA: ECONOMIC DEVELOPMENT: Employment more employment = better	
POLICY DIRECTION	
Status Quo	The appeal of the Pacific Northwest includes inexpensive, reliable power; a managed, multipurpose Columbia River; and reasonably good environmental quality. This appeal is expected to continue. The population in the Region is projected to grow about 19% between 2000 and 2015. Despite periodic downturns, employment is projected to increase significantly over the period, especially in manufaturing and services. Some of these increases are attributable to fish and widlife mitiation and recovery actions. Resource-based industries such as farming, durable goods manufacturing (timber and plywood), and nondurable goods will likely continue to decline as a share of total employment.[417] However, agriculture and timber production will remain important parts of the region's economic base in small communities.[418]
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Land retirement and productivity reduction, as a result of habitat protection efforts, could cause jobs to be lost. However, most employment effects under this Alternative would be associated with breaching dams. Dam breaching would create many temporary construction jobs. For example, breaching the John Day Dam and four lower Snake River dams would be expected to increase temporary construction jobs by about 8,000 to 10,000 jobs. At the end of the deconstruction period, however, there would be a negative result in local effects as employment and other activities were withdrawn.[419] In the long term, substantial job losses would result from increased power costs, transportation costs (due to loss of barging), and water supply costs; and loss of various recreational opportunities. In the very long-term (10 to 100 years), a restored river system and fish runs could provide some compensating employment benefits. Long-term, about 3,000 permanent jobs would be created in anadromous fisheries, power plant operation, and railroad transportation needed to offset lost barging capabilities. However, overall it is estimated that more than 10,000 permanent jobs would be lost from agriculture, barging transportation, and other related jobs.[420] Overall, employment is much worse than compared to conditions under Status Quo.
Weak Stock Focus	The employment effects would be the similar to those under Natural Focus; however, the effects would be smaller because fewer dams are breached and habitat is actively improved. For example, short-term employment gains in the lower Snake River study area would be temporary; however, in the long term, there would be a net loss of several thousand jobs. Regionwide, job losses would occur from increased transportation and utility costs and from the loss of river navigation. Also, rural communities would lose jobs as farms go out of business due to rising irrigation and transportation costs. These losses would only be partially offset by gains in transportation- and power generation-related employment.[421] However, employment may increase in these same areas from increased recreation and tourism

[417] Corps 2002b, Section 5.14.1 Regional Demographics and Employment.

[418] Marcin, T.C. 1993.

[419] Corps 2000, Section 10.4.6.2 Social Effects by Area of Impact; Corps 2002b, Section 5.11.2.4 Alternative 4—Dam Breaching.

[420] The numbers are extracted from the referenced report to best match this EIS's definition of the Natural Focus Policy Direction. Corps 2000, Table 92.

[421] Corps 2002b, Section 5.14.1 Regional Demographics and Employment, *Total Regional Impacts*.

EFFECT AREA: ECONOMIC DEVELOPMENT: Employment more employment = better	
	(including some from increased fish runs). Employment directly related to fish and wildlife mitigation and recovery actions would continue. Overall, there would be less employment than Status Quo.
Sustainable Use Focus	Land management under a multiple-use approach would likely cause a slight increase in employment associated with agricultural and forest products industries. Active habitat enhancement actions would continue to create jobs through the use of construction and related services. Employment opportunities could also increase because of increased hatchery production and harvest opportunities. There would also be increases in fish harvest and associated employment. Overall, employment would be slightly better than Status Quo.
Strong Stock Focus	There would be an increase in employment associated with increased commercial, residential, and industrial development. Lifting weak stock restrictions would allow increased economic opportunities. Jobs associated with fish harvest would also increase. Decreases in hydro operation restrictions also result in increased barging and irrigation, increasing employment opportunities in those and related economic sectors. Overall, employment is better than compared to conditions under Status Quo.
Commerce Focus	Priority is given to enhancing the economic value associated with the Columbia/Snake River System resulting in increased employment opportunities Regionwide. Decreases in restrictions associated with land use and hydrosystem operation would help stimulate growth in employment. Other areas of industry would also increase including agriculture, forest products, transportation, residential and commercial development, and recreation. There would also be increases in harvest-, hatchery- and fish farm-related employment. Overall, employment is much better than compared to Status Quo.

5.3.3.2 Funding Costs

The Pacific Northwest is home to the worlds largest, most expensive fish and wildlife mitigation and recovery program. Since the passage of the Regional Act and its express provisions requiring BPA to mitigate fish and wildlife, BPA has incurred costs over $6 billion. Other funding sources, such as Federal taxpayers, states, tribes, and private/commercial interests, have also contributed extensive resources to this program. There has been growing concern in the Region over the amount of money that is spent and the way in which it is used. As a result of this concern, the Region is seeking a long-term plan that would include predictability and stability in funding and accountability for results.

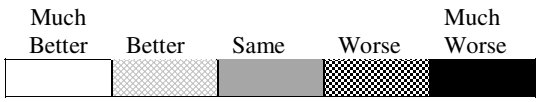
The implications of changes in funding costs affect both BPA ratepayers as well as other funding sources; therefore the analysis of the environmental consequences for funding costs is two-fold. BPA's ability to fund fish and wildlife mitigation and recovery is limited by its maximum sustainable revenue (MSR; see Section 2.3.2.3). The ability of other funding sources to fund fish and wildlife mitigation and recovery is also limited. For example, other Federal agencies are constrained by their annual budgets and appropriations from Congress, while state funding is limited by revenues generated from the sale of licenses and state taxes. Similarly, the tribes' ability to fund would also be limited by the sale of licenses and revenue generated from other sources. Further,

Federal, state, and tribal sources, as well as private/commercial funding sources, can be affected by changes in the overall economy. As the Region continues to pursue mitigation and recovery for fish and wildlife, it is possible that BPA's contribution will be limited by its MSR. Other funding sources may need to contribute additional funding in order to the meet the Region's fish and wildlife goals.

Table 5.3-6A shows how the funding costs would be affected by the Policy Directions. Effects are shown, by shading, to indicate whether under any given Policy Direction there would be an increase or decrease (as compared to Status Quo) in the ability to fund a fish and wildlife program. This ability is affected by revenues (or other sources of monies) and funding costs. An increase in the ability to fund is characterized as "better" in the table.

Table 5.3-6A: Funding Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Ratepayers						
Other Funding Sources						



Summary of Effects: The Natural Focus Policy Direction would have large effect on funding for both ratepayers and other funding sources. As a result of dam breaching, funding costs to ratepayers and other funding sources would be much higher, and their ability to fund would be much worse than under Status Quo.

Under the Weak Stock Focus effects on funding would be similar to Natural Focus. Although there would be fewer dams breached, required weak stock actions would result in the need for additional funding. Funding costs to ratepayers and other funding sources would be much higher, and their ability to fund would be much worse than under Status Quo.

Sustainable Use Focus would have costs similar to those under Status Quo, for both ratepayers and other funding sources. However, other funding sources could generate higher revenues through increases in the sale of licenses, tags, and user fees. The ability for both ratepayers and other funding sources to fund these costs would be about same as Status Quo.

Strong Stocks Focus would result in less funding costs as weak stock restrictions are lifted. Moreover, the ability of both ratepayers and other funding sources to fund fish and wildlife actions would be better than under Status Quo.

Commerce Focus would have lower funding costs for ratepayers and Federal taxpayers. Other sources might contribute more funding through the allocation of a portion of revenues from river uses and from user fees, however their ability to fund these actions would be better than under Status Quo.

The reasoning for these effects is described in greater detail in Table 5.3-6B.

Table 5.3-6B: Funding Effects Across the Policy Directions Analysis

EFFECT AREA: FUNDING COSTS: Ratepayers increased ability to fund = better	
Existing Conditions	Increased costs for fish and wildlife including foregone revenue constitute the main concerns for ratepayers with regard to fish and wildlife funding. The trend for fish and wildlife expenditures from 1996 through 2000 has been toward increased expenditures, with no plan for guiding fish and wildlife mitigation and recovery costs. Under the Memorandum of Agreement, BPA's Fish and Wildlife Program expenses (including direct program costs, reimbursables, and expenses associated with capital investments) were kept relatively stable. However, other fish and wildlife costs (related hydro operations) have resulted in overall expenses steadily increasing. This has resulted in BPA's total fish and wildlife costs ranging from approximately $260 million in 1996 to $560 million in 2000.[422] These expenditures have led to a total cost of nearly $2 billion during this 4-year period.
POLICY DIRECTION	
Status Quo	As a result of high market prices and increased customer demand, BPA was required to purchase power on the market at substantially higher and uncertain prices.[423] From 2000 to 2001, power purchases went from about $60 million to over $1.3 billion.[424] This extreme escalation in power replacement costs of well over one billion dollars was a demonstration of the influence of market prices. BPA needed to ensure that rates and revenues would be sufficient to recover its costs with a high degree of certainty. To address this problem, BPA was forced to raise its rates and incorporated several cost recovery adjustment clauses (CRACs) in its rates proposal. Drastic changes, such as those in 2001, are not expected frequently, however, BPA still needs to develop a long-term plan to stabilize fish and wildlife expenditures. Absent a plan to control costs, costs to BPA's ratepayers are anticipated to continue an escalating trend. In 2001, BPA's ratepayers funded more than $220 million for its direct program, reimbursables, and fixed expenses. BPA's *entire* Fish and Wildlife Program expenditures in 2001, including power replacement costs and foregone revenues, were more than $1.7 billion.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The removal and modification of dams under this Policy Direction would reduce the available hydropower generation, and power purchase costs would increase. For

[422] See Chapter 2 of this EIS.

[423] See Chapter 2 of this EIS.

[424] See Chapter 2 of this EIS. Note that the $1.7 billion was during drought conditions and great market price fluctuation. Even in light of the unusual drought conditions, fish and wildlife costs were expected to increase overall on an annual basis.

EFFECT AREA: FUNDING COSTS: Ratepayers increased ability to fund = better	
	example, breaching the John Day Dam and four lower Snake River dams would decrease generating capacity by about 2,000 aMW.[425] The cost of replacement power for lost hydropower alone would be in the hundreds of millions of dollars on an annual average net basis. Power rates (ratepayer costs) would go up to cover these changes.[426] It is unclear whether ratepayers or taxpayers would bear the costs of the debt service on the breached dams and the cost of breaching. However once breached, ratepayers would no longer be required to mitigate for impacts to fish and wildlife from those dams. The necessary transmission reliability and ancillary services due to the dam breaching would add additional costs in the tens of millions of dollars annually. These increased costs for transmission system infrastructure investments would result in higher transmission rates. In addition, ratepayers would continue to pay for some limited land acquisition to protect high quality habitat. However, investments in habitat would be less than that under Status Quo. There would be a reduction in funding costs from the elimination of hatcheries under this Policy Direction. The amount of the overall costs borne by ratepayers would be limited by BPA's MSR.[427] This Policy Direction could result in much higher costs for ratepayers and the ability to fund would be much worse than under Status Quo.
Weak Stock Focus	The effects of dam breaching on power and transmission would be similar to those under Natural Focus; however, the degree of impact would be less. For example, the breaching of four lower Snake River dams would reduce generation by about 800-1,000 aMW.[428] Possible wholesale rate increases to power customers could range from 0.67 to 5.86 mills/kWh.[429] It is unclear whether ratepayers or taxpayers would bear the costs of the debt service on the breached dams and the cost of breaching. However once breached, ratepayers would no longer be required to mitigate for impacts to fish and wildlife from those dams. The amount of additional lost hydropower from additional constraints for listed stocks would depend on the severity of the restrictions. The ratepayers would likely pay a large part of the increased costs for the direct actions (e.g., active habitat protection and enhancement, hatchery reformation and operation, and hydro modifications) taken to recover *all* listed species: these costs could be additional millions of dollars.[430] The costs to ratepayers would be limited by BPA's MSR. This alternative would result in much higher costs for ratepayers and the ability to fund would be much worse than would occur under Status Quo.
Sustainable Use Focus	Ratepayers would continue to fund costs for enhancing and managing fish and wildlife habitat and reforming hatchery production. These costs would not escalate to the levels required to recover all listed species. Instead funding levels would be established to achieve sustainable populations for harvest. Some savings could be

[425] See Effect Area–Power above, Natural Focus.

[426] It can be concluded from the Corps' Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (Corps 2002b) that the breaching of the John Day and drawdown of McNary dams would substantially increase costs and the BPA rates since the power from the four lower Snake River dams together only amounts to what John Day dam produces. See the Weak Stock discussion for specifics on the lower Snake River dam breaching estimates.

[427] See Chapter 2, Section 2.3.2.3 Current Policies—Conflicting Priorities, Managing the Money Resource, Challenges to Funding.

[428] Corps 2002b, Section 5.10.1.2 Power System Models.

[429] Corps 2002b, Section 5.10.3.1 Possible Power Rate Increases and Table 5.10-5: Possible Wholesale Rate Impacts Under Alternative 4 - Dam Breaching.

[430] See Appendix J, Table A.

EFFECT AREA: FUNDING COSTS: Ratepayers increased ability to fund = better	
	realized by maximizing fish transport and modifying the hydrosystem to benefit fish and wildlife—approximately $8.5 million.[431] Overall, however, costs and the ability to fund would be similar to Status Quo.
Strong Stock Focus	Some funding would be necessary for fish and wildlife habitat and fish hatchery programs in order to maintain and support strong stocks. However, these funding levels would likely be less than that under Status Quo. Maximizing fish transport and hydrosystem modifications to benefit strong stocks could result in a savings of approximately $8.5 million.[432] Increased ability to generate power from the existing hydrosystem—as weak stock restrictions are removed—would likely result in fewer power market purchases and/or less construction of replacement power. Because funding to recover weak stocks is no longer required, the overall costs to ratepayers for fish and wildlife mitigation and recovery would be less and there would be an increased ability to fund compared Status Quo.
Commerce Focus	Increased ability to generate power from the existing hydrosystem—as weak stock restrictions are removed—would likely result in fewer power market purchases and/or less construction of replacement power. However, increased development could accelerate the need for more power generation and transmission. As the need to fund recovery costs is eliminated, ratepayers continue to fund mitigation for the effects of the hydro- and transmission systems on fish and wildlife. Hatchery costs could increase as fish production increases. Overall, costs to ratepayers would be less and there would be an increased ability to fund compared Status Quo.

EFFECT AREA: FUNDING COSTS: Other Funding Sources increased ability to fund = better	
Existing Conditions	Increased funding costs for fish and wildlife are a major concern for other funding sources. In addition to ratepayers, funding for fish and wildlife comes from Federal taxpayers, states, tribes, and private/commercial contributions. Their contributions include monies from Federal appropriations, state taxes, fishing/hunting/trapping licenses and tags revenues, and user fees, among other sources. Many of the costs for fish and wildlife are spread across numerous categories of funding sources and programs, making it very difficult to accurately capture the funding expenditures for fish and wildlife mitigation and recovery.
POLICY DIRECTION	
Status Quo	The amount and share of costs from other funding sources would likely increase. There has been an upward trend for salmon expenditures by Federal agencies. Another example of rising costs is the increased price of fishing and hunting licenses for the states of Oregon and Washington.[433] Non-consumptive users of fish and wildlife could have taxes imposed on outdoor products to finance mitigation not historically covered by hunting and fishing license dollars. An accurate accounting of all fish and wildlife expenditures remains difficult because of the fragmentation in funding and programs.

[431] Corps 2002b, Section 5.10.2.2 Alternative 2—Maximum Transport of Juvenile Salmon and Alternative 3—Major System Improvements; Corps 2000, Section 10.2 National Economic Development.

[432] Corps 2002b, Section 5.10.2.2 Alternative 2—Maximum Transport of Juvenile Salmon and Alternative 3—Major System Improvements; Corps 2000, Section 10.2 National Economic Development.

[433] State of Oregon, Archives Division 2001; State of Washington 2002a.

EFFECT AREA: FUNDING COSTS: Other Funding Sources increased ability to fund = better	
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The removal and modification of dams under this Policy Direction would reduce the revenues generated by the multiple uses of the hydrosystem. It is unclear whether ratepayers or taxpayers would bear the costs of the debt service on the breached dams and the cost of breaching. Federal taxpayers could be required to pay substantial costs for dam breaching, including appropriations to the Federal operating agencies. Federal land management agencies may be required to fund more habitat actions. In addition, regulatory costs (e.g., restricting human access, monitoring commercial harvest) might also be high. Some funding sources may lose revenue as restrictions in access and harvest affect license revenues and user fees. Further costs may be incurred if BPA's funding is limited by its MSR. However, the ability of other funding sources may be limited by economic conditions. The costs to other funding sources would be much higher and their ability to fund would be much worse than under Status Quo.
Weak Stock Focus	The impact of dam breaching on funding costs would be similar to that under Natural Focus; however, the effect would be less as fewer dams are breached. Federal taxpayers could be required to pay substantial costs for dam breaching, including appropriations to the Federal operating agencies. Other funding sources would likely pay a large part of the increased costs for the direct actions. For example, Federal land managers, states and tribes would likely pay for habitat and hatchery actions, while Federal operating agencies would fund hydro modifications at the remaining dams. Other actions could be taken in harvest, such as fleet buybacks. These costs could be additional millions of dollars.[434] Further costs may be incurred if BPA's funding is limited by its MSR. However, the ability of other funding sources may be limited by economic conditions. Revenues from licenses and fees would likely be similar to Status Quo. The costs to other funding sources would be much higher and the ability to fund would be much worse compared to Status Quo.
Sustainable Use Focus	The Region would face costs for fish and wildlife habitat and increasing hatchery production—costs which would be partially funded by other funding sources. These costs would not escalate to the levels required to recover all listed species; instead funding levels would be established to achieve sustainable populations for harvest. Other funding sources could generate more revenue from the sale of licenses, tags and user fees as fish and wildlife are enhanced and managed for harvest. The costs to other funding sources, and their ability to fund, would be about the same or slightly better than Status Quo.
Strong Stock Focus	With the change in focus away from recovering listed species, there would likely be a decreased financial burden on other Federal agencies, states, and tribes. Funding would still be required for the maintenance of strong fish and wildlife populations. Some funding would be used for fish and wildlife habitat and hatchery programs developed to maintain and support strong stocks. There would likely be less financial burden on other funding sources and their ability to fund would be better than under Status Quo.
Commerce Focus	No additional financial burden on Federal taxpayers would be likely, but state and private/commercial costs could increase and be spread among the various resource users. Their ability to fund fish and wildlife actions could be achieved by increased revenues from user fees and commercial development. Also, other fish and wildlife actions would be funded through incentive-based programs. Overall, there would

[434] See Appendix J, Table A.

EFFECT AREA: FUNDING COSTS: Other Funding Sources increased ability to fund = better	
	likely be less financial burden on other funding sources and their ability to fund would be better than under Status Quo.

5.3.3.3 Tribal Interests

Native American Indians have unique concerns that transcend their roles in the non-tribal economy. The inherent values of the land, water, plants, and fish and wildlife are vital to the spirituality, tradition, and health of the Northwest tribes. Stewardship of the earth's natural resources and the use of these resources for subsistence and ceremonial uses are important parts of tribal culture. The Columbia River Inter-Tribal Fish Commission notes that the "tribal vision" is one of a healthy Columbia River Basin where plants, fish and wildlife are healthy and self-sustaining.[435]

Table 5.3-7A shows how the Policy Directions could affect tribal culture. The effects of these Policy Directions on tribal harvest, health, spirituality, and tradition are in addition to those economic and social impacts that tribal members experience in common with others in the Pacific Northwest. Tribal health is associated with consumption of traditional foods, and with additional fishing income that enables a healthier life style and better health care. Spirituality is associated with a connection to the earth and with the ability to observe and practice religious and cultural traditions. Traditions include the ability to use traditional resources and places at traditional times in traditional ways (i.e., tribal land use).

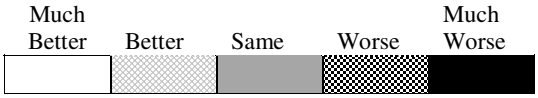
Potential changes are shown, by shading, to indicate whether a given Policy Direction would tend to have effects in the identified subcategory that are the same as, better than, or worse than Status Quo. More harvest and more health, spirituality and tradition are characterized as "better" in the table.

Table 5.3-7A: Effects on Tribal Interests Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Fish Harvest						
Health						
Spirituality						

[435] CRITFC 1999.

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Tradition						



Summary of Effects: Under the Natural Focus alternative, tribal harvest opportunities would be much worse, compared to Status Quo, because hatcheries would be eliminated, access restricted, and harvest would be limited until populations become stable. Tribal health and tradition would be worse due to the decrease in harvest. Health could further be reduced by potential increased toxicity of fish and loss of economic opportunities. However, spirituality could be improved based on the return of a more natural river and naturally-spawning salmon.

Under Weak Stock, tribal harvest would be worse than under Status Quo because harvest would be reduced and hatcheries would be reformed to assist weak stock. However, health would be about the same as Status Quo as employment opportunities offset a reduction in fish harvest. Spirituality and tradition would be better because of access to previously inundated ancestral lands and increased traditional fishing opportunities.

Sustainable Use Focus would provide increased harvest opportunities as populations of naturally-spawning and hatchery-produced anadromous and resident fish increase. The establishment of sustainable resident fish populations would allow for increased harvest in blocked areas. Tribal health, spirituality, and tradition would be better because of increasing fish and wildlife populations as habitat is enhanced.

Under the Strong Stock Policy Direction, tribal harvest would be better compared to Status Quo, largely because of hatchery supplementation of strong stocks. Tribal health would also be better because of the increased harvest of fish and wildlife. However, spirituality and tradition would be worse than Status Quo, as some species important to particular tribes are lost and some areas of spiritual value are developed.

Under Commerce Focus, tribal fish harvest would likely be better than Status Quo, as hatchery and fish farm production increases. However, tribal health is likely to be worse because of the increased potential from higher rates of fish toxicity from pollution in an increasingly developed river. Tribal spirituality and tradition would be much worse as commercial development increases, and traditional fishing sites and areas of spiritual importance are adversely affected.

The reasoning for these effects is described in greater detail in Table 5.3-7B.

Table 5.3-7B: Tribal Effects Across the Policy Directions Analysis

EFFECT AREA: TRIBAL INTERESTS: Fish Harvest more tribal harvest = better	
Existing Conditions	A major concern for tribal harvest, as it relates to fish and wildlife management, is the availability of sufficient numbers of fish for harvest. Anadromous fish (such as salmon, steelhead, and lamprey) and resident fish (such as white sturgeon, bull trout, and cutthroat trout) are of great cultural significance to Native American Indian peoples. Salmon are a major food source and trading commodity for most Columbia Basin tribes. The cultural significance of the salmon is honored in tribal cultures just as much today as in the past. Native American Indians revere salmon (steelhead included) as one of many divinely provided traditional foods, and as a designated "lead fish" essential on the tables at community dinners. A large catch of fish (enough to consume, sell, and give away) brings social esteem to both the fisherman and the skilled salmon handlers who prepare and serve the catch.[436] The tribal harvest has been substantially reduced from historic levels, especially for anadromous fish.[437] The ability of the Federal government to meet trust responsibilities as it pertains to fish harvest has been limited because of the diminished resident and anadromous fish populations.[438] Most of the upriver anadromous fishing opportunities have been lost.
POLICY DIRECTION	
Status Quo	The tribal harvest has continued to fall below the levels desired by the tribes. Although many fish habitat projects have been planned and implemented, harvest opportunities are expected to be restricted for many more years. In 1999, the Columbia River Basin hatcheries produced more than 140 million anadromous fish to help supplement the fisheries.[439] Recently, some upriver harvest opportunities have been developed: for instance, upriver bright fall chinook are being reared in hatchery facilities for release in the Hanford Reach of the mid-Columbia River to enhance the upriver fishery. About 12 million smolts are released annually—a number about four times greater than the projected natural smolt yield.[440] However, expectations are that the declining trends in some of the fish populations will continue, further limiting harvest.[441]
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Initially, tribal fish harvest would be restricted allowing only ceremonial and subsistence fishing. As wild anadromous fish populations increase, more harvest could occur, but it would be limited to surpluses above naturally stable populations. In the long-term, dam breaching could restore some fish runs. For example, based on breaching the four lower Snake River dams, the Tribal Circumstances report[442] indicated that wild stocks of spring/summer and fall chinook salmon and steelhead would likely be stabilized, and in the long run lead to increases in the populations to near recovery levels: this could mean almost 2.5 times more tribal harvest opportunities of Snake River wild and hatchery fish. In addition, drawdown of the

[436] Corps 2002b, Appendix N, Section 1.2.4.4.

[437] Corps 2002b, Section 4.1.2 Human Environment.

[438] USDOE/BPA, Corps, and Bureau 1995, Section 4.3.

[439] NMFS 1999c.

[440] Corps 2000, Section 4.18.4 Hatchery Production.

[441] Corps 2002b, Section 5.8.1.2 The Alternatives and Their Effects.

[442] Corps 2002b, Section 4.8 Native American Indians.

EFFECT AREA: TRIBAL INTERESTS: Fish Harvest more tribal harvest = better	
	John Day Dam to natural river level could possibly result in an estimated 8- to 10-fold increase in fall chinook salmon spawning capacity below McNary Dam. However, eliminating the hatchery programs would likely cause a decrease in numbers of harvestable fall chinook in the John Day reach.[443] Hatchery fish account for about 80%, 50%, and 90% of projected total tribal harvest of fall chinook, spring/summer chinook, and steelhead, respectively.[444] Harvestable numbers of resident fish would be reduced in areas behind the breached dams, although some native species could fare reasonably well. Although lost habitat could cause some resident fish (e.g., sturgeon) to decline, other resident species would increase—allowing harvest.[445] Treaty fishing sites would need to be relocated and modified if a drawdown is implemented.[446] Overall, the tribal fish harvest under this Policy Direction would likely be much worse than under Status Quo.
Weak Stock Focus	The effects from dam breaching would be similar to those under Natural Focus, but to a lesser extent. The active habitat restoration for listed species would increase the population levels of naturally-spawned anadromous fish; modifying the hatcheries would also increase the overall production of weak stocks. Closing hatcheries for all but conservation purposes—using hatcheries only for preserving genomes, not for supplementation or production for harvest—could severely reduce the number of fish available for harvest. The tribes would likely adopt more selective harvest methods to avoid weak stocks. Tribal harvest would be reduced to assist the recovery of weak stocks. Overall, the long-term effects of this Policy Direction on tribal fish harvest would be worse than those under Status Quo.
Sustainable Use Focus	Tribal fish harvest would improve as the naturally-spawning and hatchery-produced fish populations increased. Habitat management, changes in hydro operations, and the increase in hatchery production would increase the overall number of harvestable resident and anadromous fish. The creation of a sustainable resident fishery would likely increase upriver fish harvest. The tribal fish harvest would be better than under Status Quo.
Strong Stock Focus	Tribal fishing would increase, as the healthy stocks are maintained and hatcheries are operated to support them. As weak stock restrictions are lifted, harvest of these stocks could increase initially. However, this source of harvest would be temporary because of the limited viability of these stocks. An increase in hatchery-produced strong stocks would likely compensate for the loss of weak stocks and would be used to maintain or increase tribal harvest. Overall, tribal fish harvest would be better compared to that under Status Quo.
Commerce Focus	There may be some loss of anadromous fish production in upstream areas as weak stock programs are discontinued. Increased tribal fish harvest would be created through the artificial production and fish farming of desirable fish. More emphasis would be placed on establishing hatchery-supported resident fisheries in upriver areas. Overall, tribal fish harvest would be better than that under Status Quo.

[443] Corps 2000, Section 7.17.5 Potential Change in Harvest Benefits from Restored Natural Production Below McNary Dam.

[444] Corps 2002b, Sections 5.8.1.1 Projected Harvest Numbers, Hatchery Fish Assumptions, and 5.8.1.2 The Alternatives and Their Effects.

[445] Corps 2002b, Section 5.8.1.2 The Alternatives and Their Effects; Corps 2000, Section 7.17.7 Potential Impacts on Resident Fish and Habitat.

[446] Corps 2000, Section 7.20 Tribal Impacts.

EFFECT AREA: TRIBAL INTERESTS: Health, Spirituality, and Tradition more = better	
Existing Conditions	A major concern for tribes is the effect of fish and wildlife management activities on their health, spirituality, and tradition. Native American Indians believe that there is a close physical and spiritual interrelationship between humans and nature. They view human existence as an integral part of the natural and spiritual worlds. "For the tribes there has been a common understanding—that their very existence depends upon their respectful enjoyment of the Basin's rich and vast land and water resources."[447] The river itself, the salmon, oral traditions, useful plants, cultural sites, and the resting places of ancestors are interconnected in the tribal worldview.[448] Numerous fish, wildlife, and plants (e.g., salmonids, lamprey, sturgeon, whitefish, sculpin, deer, eagles, bear, cous, Indian carrots, chokecherries, and tules) retain cultural significance to Native American Indian tribes.[449] In fact, "salmon are a part of [their] spiritual and cultural identity."[450] As a primary food source for thousands of years, salmon continue to be an essential component of the tribes' nutritional health. In addition, salmon are vital to traditional practices. "The annual return of salmon allows for the transfer of traditional values from generation to generation."[451] Health, spirituality, and tradition have been impaired by the loss of subsistence and ceremonial fish harvest, wildlife, and access to traditional lands. For example, the fisheries on and adjoining the lower Snake River system have been significantly altered over the past 150 years in terms of access to usual and accustomed places and habitat quality. Tribes that desired to take fish such as Pacific lamprey (largely a ceremonial and subsistence activity) have had their fishermen displaced from local fishing stations.[452]
POLICY DIRECTION	
Status Quo	The Native American Indian community is concerned with the continued degradation of the air, land, and water, and the effects of this degradation on the places they hold sacred. This deterioration of the natural world also includes the decline and loss of some species of plants, fish, and wildlife that have sustained them. Recently, there has been increased concern about heavy metal bioaccumulation in salmon and its disproportionate affect on tribal health (as their consumption of salmon is higher than salmon consumption in the general population). Tribal governments have increasingly sought legal avenues to have their tribal rights honored. As part of agreements made when the tribes ceded lands to the U.S. Government, tribes typically retained rights to hunt, fish and gather. Efforts have been made recently to assess the impact of Federal agency activities on tribes and to ensure that tribal interests and rights are adequately considered before Federal actions are undertaken.[453] Ensuring tribal health, spirituality, and tradition is likely to become more challenging with the increasing pressure on natural resources from population growth and urbanization.

[447] CRITFC 1999, p.2.

[448] Corps 2000, Section 4.20.1 Tribal Cultural Resources Perspectives.

[449] Corps 2002b, Section 4.8 Native American Indians.

[450] CRITFC 1996, Executive Summary.

[451] CRITFC 1996, Executive Summary.

[452] Corps 2002b, Appendix Q.

[453] Corps 2002b, Appendix Q.

EFFECT AREA: TRIBAL INTERESTS: Health, Spirituality, and Tradition more = better	
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The breaching of six dams in the Columbia River and its tributaries would in the long term return the previously inundated lands to a more natural appearance. However, tribal access would continue to be limited. The removal of the six dams would disturb heavy metal-laden sediment that could bioaccumulate in salmon and further reduce tribal health. The elimination of hatcheries and a decrease in overall harvest could allow naturally spawning anadromous fish to increase, which could enhance spirituality, but reduce tribal health and tradition. Over the long-term, passive restoration efforts would likely increase the abundance of some wildlife and naturally spawning fish. Overall, tribal health and tradition would be worse, while spirituality would be better than under Status Quo.
Weak Stock Focus	The effects would be similar to those of Natural Focus, although dam breaching would be limited to the lower Snake River dams, and habitat for listed fish and wildlife species would be actively restored. For example, approximately 14,000 acres of inundated land would be exposed by the dam breaching in the lower Snake River reach,[454] and rehabilitated. The newly exposed lands would be accessible to the tribes for spiritual and traditional use. Some tribes believe that dam breaching would allow tribal communities to renew their close religious/spiritual connection with the ancestral lands.[455] Breaching the four lower Snake River dams and active habitat restoration would increase listed species including salmon, creating a positive effect on the tribes' ceremonial harvest.[456] Further habitat enhancements would result in increases in important native plant and wildlife species. Tribal health would be reduced due to lower fish harvests, but could be slightly improved as weak stock actions result in improved tribal employment opportunities. Overall, tribal health would be about the same as Status Quo while spirituality and tradition would be better than Status Quo.
Sustainable Use Focus	The health, spirituality, and tradition of some tribes, especially downriver, would improve from increased fish and wildlife harvest opportunities created by enhancing and managing habitat. As the upriver focus further shifts to resident fish, harvest opportunities would increase and benefits to health would follow. Important wildlife populations would also increase as habitat was enhanced. These increases in fish and wildlife could help enhance spirituality. Improved hydro operations for fish and wildlife, increased hatchery production, and decreases in commercial activity where it would affect fish and wildlife production would likely further increase harvest opportunities, improving tribal health. Tribal health could be further improved as fish and wildlife management actions and harvest result in improved tribal employment opportunities. Overall, tribal health, spirituality, and tradition would be better than under Status Quo.
Strong Stock Focus	There would be an increase in strong fish and wildlife populations—especially resident and hatchery-produced fish—allowing increases in harvest that would improve tribal health. However, further loss of weak populations of native fish and wildlife could be damaging to tribal traditions and spirituality. This damage to tradition and spirituality would result from the loss of species important to individual tribes. Spirituality and tradition could further be affected by increased development

[454] See Weak Stocks explanation under Land Habitat above.

[455] Corps 2002b, Section 4.8 Native American Indians.

[456] See Weak Stocks explanation under the anadromous fish discussion for the Fish and Wildlife section above.

EFFECT AREA: TRIBAL INTERESTS: Health, Spirituality, and Tradition more = better	
	in areas of cultural importance. Overall, tribal health would be better, while spirituality and tradition would likely be worse than under Status Quo.
Commerce Focus	Tribal tradition and spirituality would be adversely affected by loss of traditional fishing practices and locations, changes in fishing techniques, and more competition from an increase in the non-Indian use of natural resources. The likely increase in development would also negatively affect tribal traditions and spirituality. These same increases in commercial activity, as well as the creation of tribal hatcheries and fish farms, could increase employment opportunities for tribal members. Increases in fish production would result in better health for tribal members, although this might be offset by other factors, such as heavy metal accumulation in the fish from increases in pollution. The more commercial the river, the more opportunities there would be for impacts on tribal spirituality and tradition. Overall, tribal health would be about the same as under Status Quo; spirituality and tradition would be much worse than under Status Quo.

5.3.3.4 Cultural and Historic Resources

Table 5.3-8A shows how the Policy Directions might affect cultural and historic resources. Historic resources are broadly defined to include "any prehistoric or historic district, site, building, structure, or object included in or eligible for the National Register of Historic Places."[457] Cultural resources include properties of religious and cultural importance to Native American Indian tribes. Changes are shown, by shading, to indicate whether a given Policy Direction would tend to have effects that are the same as, better than, or worse than Status Quo. Changes that result in the loss of cultural and historic resources are characterized as "worse" in the table; changes that preserve cultural and historic resources are "better."

Table 5.3-8A: Cultural and Historic Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Cultural and Historic Resources						

Much Better | Better | Same | Worse | Much Worse

Summary of Effects: The most important sources of effects are exposure of inundated sites and destruction of historic structures. Both Natural Focus and Weak Stock Focus Policy Directions would result in the exposure and possible destruction of many inundated sites as a result of dam breaching. Also, the resulting loss of power would require more generation and transmission construction, potentially disturbing other sites. The effects of these two Policy Directions would be much worse than the effects under

[457] National Historic Preservation Act. Section 106 Regulations, 36 CFR Sec. 800.16 Definitions.

Status Quo. Under Sustainable Use and Strong Stock, reservoir levels would be more stable, though development would increase, resulting in similar impacts to cultural and historic resources as Status Quo. Although there would be more stable reservoir levels and less exposure to inundated sites, the increased development under Commerce Focus would cause greater impacts to cultural and historic resources than Status Quo.

The reasoning for these effects is described in greater detail in Table 5.3-8B.

Table 5.3-8B: Cultural and Historic Effects Across the Policy Directions Analysis

EFFECT AREA: CULTURAL AND HISTORIC RESOURCES fewer impacts = better	
Existing Conditions	Impacts to cultural and historic resources are a concern related to actions taken for fish and wildlife. Many cultural and historic sites carry special significance and are protected by law. Sites that are potentially eligible for the National Register of Historic Places, but which have not been evaluated as to eligibility, are required to be protected under the National Historic Preservation Act. There are many cultural and historic resources within the Pacific Northwest. However, many states lack accurate information about site locations, elevations, characteristics, densities, and depths of deposit; the location of many resources are unrecorded. There is evidence that both archaeological and historic sites are more numerous, generally larger, and more complex, along the former riverbanks.[458] The losses of cultural and historic resources in the Region have been extensive. Many sites have been inundated by reservoirs or covered by sediment as a result of the construction of the FCRPS. Many other sites have been disturbed or destroyed by development. The major impacts on cultural and historic resources are from high water flows, wave action, and human activities (e.g., development, vandalism).[459] Also, unrecorded sites are exposed as a result of ongoing operations at hydroprojects.[460]
POLICY DIRECTION	
Status Quo	Efforts related to cultural and historic resources include funding of resource mitigation, and recording of Traditional Cultural Properties, oral histories, and place names. The recorded sites continue to be formally evaluated for National Register eligibility because the vast remainder of the recorded sites may be potentially eligible for inclusion in the Register.[461] Local, state, and Federal regulations of cultural and historic resources provide some protection from new development. Even with the protection in place, additional losses of historic and cultural resources would likely occur. These losses would result from residential, commercial, and industrial development; hydrosystem operations; and recreational activities.
	Effect in Comparison to the Status Quo Condition:
Natural Focus	The breaching and drawdown of dams to natural river levels would expose more sites. Formerly inundated areas would lack protective vegetation and mantling soils. Many exposed sites would become more vulnerable as targets for vandalism and

[458] Corps 2000, Section 4.20 Cultural Resources

[459] Corps 2002b, Appendix N Cultural Resources.

[460] Corps 2000, Section 4.20 Cultural Resources.

[461] Corps 2000, Section 4.20 Cultural Resources.

EFFECT AREA: CULTURAL AND HISTORIC RESOURCES fewer impacts = better	
	looting, and more prone to damage by erosion as the river returns to a more natural state.[462] Limiting human access to important fish and wildlife habitats would help reduce this vulnerability. Protection of the exposed sites would substantially increase the costs to maintain cultural and historic resources. For example, within the John Day Dam and the four lower Snake River dam reservoir areas are more than 600 known sites, some of which are partially or completely inundated.[463] As drawdowns occurred, sites would need to be recorded and assessed, and law enforcement would need to be increased. Additional support and training for prosecuting cases under the Archaeological Resources Protection Act would also be required.[464] Loss of hydropower production would require new generation construction, which could potentially disturb cultural and historic sites. To the extent that changes in the transmission system would result from hydropower losses, impacts on sites could result from construction, operation, and maintenance of transmission-line corridors.[465] The overall impact would be much worse than that under Status Quo.
Weak Stock Focus	The type of effects would be similar to Natural Focus; however, the extent of impacts would be less. For example, within the reservoirs of the four lower Snake River dams there are approximately 375 known sites, some of which are partially or completely inundated.[466] Under this Policy Direction, these sites would be exposed. While exposure would make cultural resources accessible for study and tribal use, it would also subject them to the fluctuations of a near naturally flowing river, erosion, increased human access, and trampling by animals. Human recreational activities at the exposed sites could result in vandalism and looting. Sites would be protected where new industrial, residential, and commercial development was restricted for listed species. Overall, impacts to resources would be much worse than those under Status Quo.
Sustainable Use Focus	Historic and cultural properties could be affected by improvements in hydrosystem operation strategies for fish and wildlife. For example, certain river operations to improve fish populations may involve the modification of structures such as spillways, dam embankments, turbines, and fish passage facilities, potentially causing direct effects on historic or cultural properties. Overall, however, the impacts to resources from this Policy Direction would be similar to those under Status Quo.
Strong Stock Focus	Since no actions would be taken to benefit listed species of fish, reservoirs would remain more constant, resulting in less exposure of sites. However, there could be some losses of unprotected sites as development and urbanization increases. The local, state, and Federal protections existing under Status Quo would be similar. Overall, the impacts on cultural and historic sites would be similar to those under Status Quo.
Commerce Focus	There would likely be less exposure of inundated sites than under Status Quo, as flow and spill regimes for listed anadromous fish would be abandoned. However, there would be increased losses of unprotected sites as development and

[462] Corps 2000, Section 7.19 Cultural Resource Impacts.

[463] Corps 2002b, Appendix N Cultural Resources; Corps 2000, Section 4.20.5 Existing Cultural Resources.

[464] Corps 2000, Section 7.19 Cultural Resource Impacts.

[465] Consult Appendix J of this EIS for an estimate of the affected area, and the discussion of Transmission in this section for an understanding of why transmission could be affected by this alternative.

[466] Corps 2002b, Section 4.7.5 Identified Historic and Archaeological Sites.

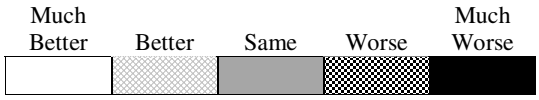
EFFECT AREA: CULTURAL AND HISTORIC RESOURCES fewer impacts = better	
	urbanization increased. The local, state, and Federal protections existing under Status Quo would be similar. Overall, the impacts on cultural and historic resources would be worse than those under Status Quo.

5.3.3.5 Aesthetics

Table 5.3-9A shows how the Policy Directions might affect aesthetics. Aesthetics is described in terms of scenery—the product of both natural processes and human culture, combined in various proportions that change over time. However, sounds and smells are also aesthetics parameters. Aesthetics is a value judgment: an attribute that someone finds aesthetically pleasing may be displeasing to someone else. Aesthetics includes the difficult-to-measure qualities of the environment that are important to the emotional well-being of the residents of the Pacific Northwest. The alternatives are compared by evaluating the impacts on the landscape. Changes are shown, by shading, to indicate whether a given Policy Direction would tend to have effects on the landscape that are the same as, better than, or worse than those under Status Quo. Diminished aesthetics are characterized as "worse" in the table.

Table 5.3-9A: Aesthetics Effects Across the Policy Directions Summary

		Focus of Alternative Policy Directions				
Effect Subcategory	**Status Quo**	**Natural**	**Weak Stocks**	**Sustainable Use**	**Strong Stocks**	**Commerce**
Aesthetics						



Summary of Effects: Under the Natural Focus Policy Direction, a stretch of natural, free-flowing river would be restored. However, reservoir bottoms would be exposed as a result of the breaching of up to six dams. This could affect the value of the area's aesthetics until natural regeneration occurred. Also, much of the aesthetic value gained from breaching would not be enjoyed because of restricted access. Therefore, although there would be an increase in potential aesthetic value, that value likely would not be realized. In fact, aesthetics would be worse than under Status Quo.

Under Weak Stock, the exposed reservoir bottoms would regenerate much faster than under Natural Focus because of active habitat improvements. Also, the aesthetic value of the areas would be enjoyed because access would not be as limited as under Natural Focus. The aesthetic value under Weak Stock Focus would be substantially better than that under Status Quo. Under the Sustainable Use, some fish and wildlife habitat would be improved and some shoreline fluctuations might result from hydro modifications to improve fish populations. Aesthetics under this Policy Direction would be about the

same as those under Status Quo. Under the Strong Stock Focus Policy Direction, the relaxing of restrictions to benefit listed species would result in increased development. Aesthetics would be worse than under Status Quo. The increase in commercial, industrial, and residential development, as well as the decrease in habitat activities, would result in worse aesthetics under Commerce Focus than under Status Quo.

The reasoning for these effects is described in greater detail in Table 5.3-9B.

Table 5.3-9B: Aesthetics Effects Across the Policy Directions Analysis

EFFECT AREA: AESTHETICS fewer impacts = better	
Existing Conditions	Impacts to aesthetics, particularly scenery, is a major concern related to fish and wildlife activities. Approximately 26% of the landscape has been transformed by humans to the degree that the overall images are no longer near natural in appearance, but are culturally dominated.[467] Five themes describe landscape aesthetics in the Pacific Northwest: (1) naturally evolving forest and shrub/grasslands (7% of the landscape); (2) natural-appearing forestlands (37% of the landscape); (3) natural-appearing shrub/grasslands (30% of the landscape); (4) agricultural lands (20% of the landscape); and (5) developed areas (6% of the landscape).[468] Landscape aesthetics, including viewing scenery, is an important concern for nearly 20% of the region's human population.[469] Aesthetics is also important to the ever-increasing number of visitors and the economies that depend on them. Therefore, the demand for good visibility is high. The vast majority of landscape settings within the Pacific Northwest have excellent air quality.[470] However, monitoring data from the U.S. Forest Service and National Park Service indicate that some Class I areas (as defined under the Clean Air Act) are impaired.[471] There are also increasing concerns about regional haze, especially in the Columbia River Gorge National Scenic Area.
POLICY DIRECTION	
Status Quo	The Region has a projected population growth of about 19% between 2000 and 2015 and would result in a projected regional firm energy load growth of nearly 2400 MW. This load growth would be met mostly with combustion turbines, and some renewable energy resources, such as wind.[472] Effects on aesthetics would be greatest where new or existing generating facilities cause changes in the character or condition of the landscape, especially where visibility is an issue.[473] More land would likely be developed as population growth continued, reducing the quality of those natural landscapes. Changes in reservoir operations, primarily drafting, can also have pronounced aesthetic effects on the reservoirs and adjacent lands. Overall, a future decrease in aesthetics is expected.

[467] USDA/USFS and USDOI/BLM 1997, p. 1960.

[468] USDA/USFS and USDOI/BLM 1997, p. 1961.

[469] USDA/USFS and USDOI/BLM 1997, p. 1964.

[470] USDA/USFS and USDOI/BLM 1997, p. 1964.

[471] USDOE/BPA 2002f, Section 3.17 Cumulative Effects.

[472] See above Table 5.3-5B Economic Effects Across the Policy Directions.

[473] See Clean Air Act, 42 U.S.C. §§ 7401-7492 (2000).

EFFECT AREA: AESTHETICS fewer impacts = better	
	Effect in Comparison to the Status Quo Condition:
Natural Focus	Dam breaching and drawdown of the reservoirs would expose land that would be barren until naturally revegetated, impairing aesthetic values in the short-term. The aesthetic feeling and attraction that water provides would be gone from many of the shoreline parks, which provide for the general enjoyment of the river.[474] Long-term landscaping would be difficult to establish without irrigation and frequent maintenance due to the arid environment (and inherent temperature extremes in summer and winter).[475] An increased probability of severe wildfires could also reduce scenic quality in the short term.[476] The physical appearance of the additional generating resources needed to replace the hydropower lost from breaching, as well as the potential visual impairment of viewsheds from increased air emissions, would negatively affect the landscape. Much of the aesthetic value gained from breaching would not be enjoyed because of restricted access. Overall, aesthetics will be worse than those under Status Quo.
Weak Stock Focus	The effects on aesthetics from dam breaching would be similar as those under Natural Focus, but to a lesser degree (e.g., less replacement power required and less reservoir bottom exposure). However, unlike Natural Focus, access to previously inundated areas would be allowed, and active habitat enhancement would further improve the aesthetics of those areas. There would also be aesthetic value gained by a return to a natural river landscape, one uninterrupted by large-scale hydro development. Habitat enhancement for listed fish and wildlife would also take place in other areas, further improving the aesthetic value of the Region. There would be increased opportunities to enjoy the additional aesthetic values created by the restoration of habitat for listed species. There would likely be some short-term adverse effects (from dam breaching) on aesthetics. However, over the long term, aesthetics would be substantially better than under Status Quo.
Sustainable Use Focus	Improvements in hydro operations intended to benefit fish and wildlife could cause some fluctuations in reservoir shorelines. Water rights acquired (e.g., from irrigated lands) and left instream for fish and wildlife could improve aesthetics in other areas. There are unlikely to be changes in hydrosystem operations that require additional power replacement, therefore impacts to visibility would be similar to Status Quo.[477] The enhancement of fish and wildlife habitat would result in aesthetic improvements to the landscape. Overall, aesthetics would be about the same as Status Quo.
Strong Stock Focus	Development activities would increase as long as strong fish and wildlife populations were not affected. More land could be developed to meet growing needs. There would likely be more urbanization and development. Restrictions intended to preserve and recover listed species would be removed. Overall, there would be a decrease in aesthetic compared to conditions under Status Quo.
Commerce Focus	Increased urbanization and industrialization would typically result in negative effects on the landscape. However, these effects could be limited by the need to avoid economic losses in tourism, especially for those areas that attract large numbers of visitors. Aesthetics in natural areas would diminish if development would be a more valuable use of the area. Overall, there would be more impacts on aesthetics than under Status Quo.

[474] Corps 2000, Section 7.19 Cultural Resource Impacts.

[475] Corps 2000, Section 7.19 Cultural Resource Impacts.

[476] USDA/USFS and USDOI/BLM 1997, Chapter 4.

[477] See above Table 5.3-5B Economic Effects Across the Policy Directions.

5.4 ENVIRONMENTAL CONSEQUENCES OF RESERVE OPTIONS

Reserve Options are a tool that can be used to respond to changes in fish and wildlife policies. For a complete discussion of Reserve Options please see Section 4.2. All of the Policy Directions, discussed in Chapter 3, were characterized regarding their differences from Status Quo. These differences were divided into six components— habitat, harvest, hatcheries, hydro, commerce, and tribal harvest. These Reserve Options incrementally extend or intensify each of these six components (see Figure 5-20). With each step toward the endpoint of the Reserve Option, natural, economic, and social environmental effects would become more intense and extensive, although the *kinds* of effects anticipated would remain the same. The relationship methodology provides the analytical flexibility needed to assess the Reserve Options.

The Reserve Options are mutually exclusive. Individual Reserve Options can be substituted for the corresponding components in any of the Policy Directions. Some Reserve Options may be incompatible, however; others may result in unexpected synergistic effects.

Reserve Options (RO) 1 through 6 extend the components of the Natural Focus Policy Direction to their extremes. These Reserve Options include the following:

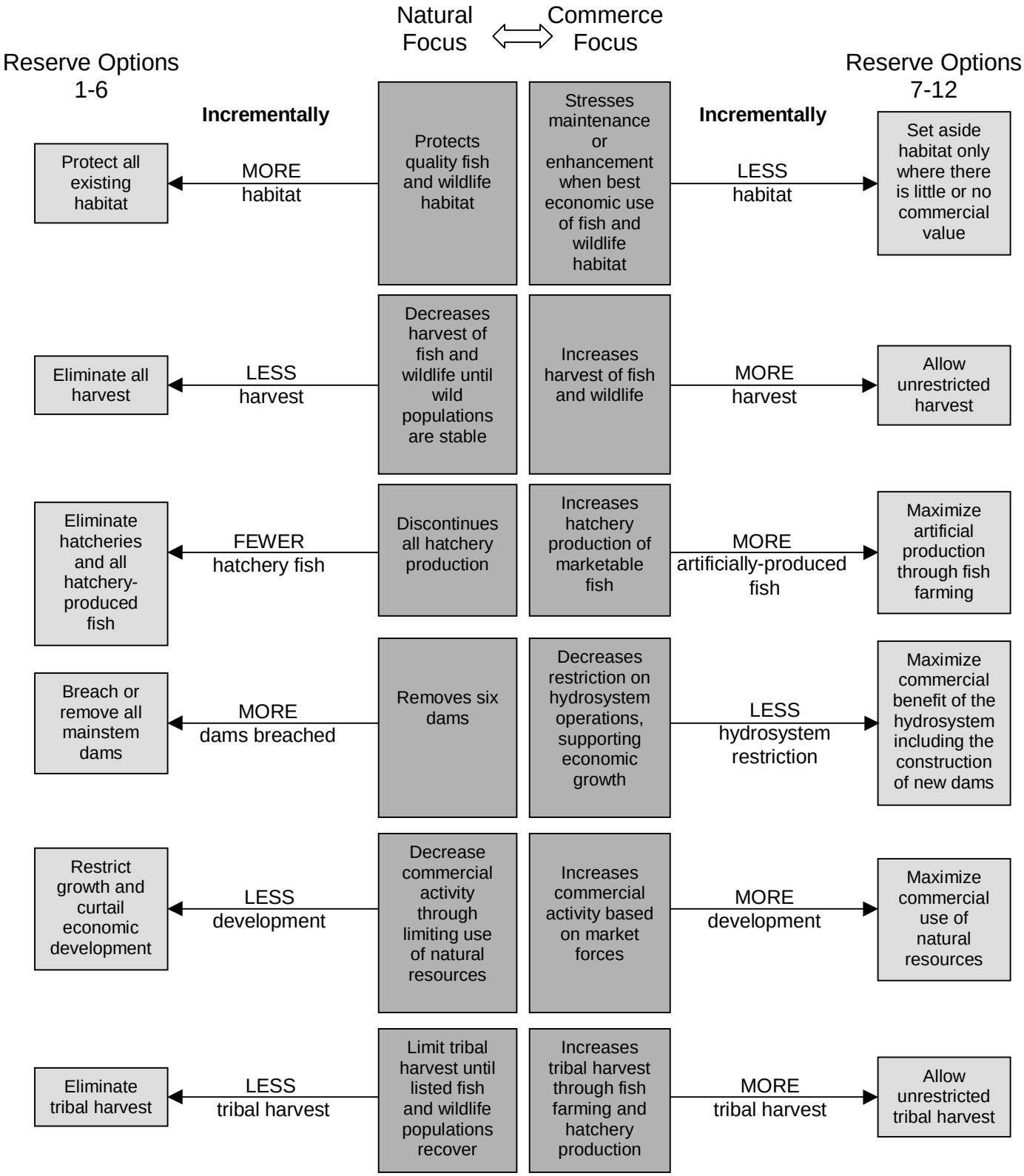
- RO-1: Protect all levels of habitat;
- RO-2: Ban all harvest;[478]
- RO-3: Eliminate hatcheries and all hatchery-produced fish;
- RO-4: Breach or remove all mainstem dams;
- RO-5: Restrict growth and curtail economic development; and
- RO-6: Eliminate tribal harvest.

RO-7 through RO-12 extend the components of the Commerce Focus Policy Direction to their extremes. These Reserve Options include the following:

- RO-7: Set aside habitat only where there is little or no commercial value;
- RO-8: Allow unrestricted harvest;
- RO-9: Maximize artificial production through fish farming (private sector);
- RO-10: Maximize commercial benefits of the hydrosystem, including the construction of new dams;
- RO-11: Maximize commercial use of natural resources; and
- RO-12: Allow unrestricted tribal harvest.

[478] Allow unrestricted harvest of hatchery-produced fish until they are eliminated.

Figure 5-20: Continuum of Reserve Options



The following is a description of the possible environmental consequences of these Reserve Options compared with Status Quo. The discussion of environmental consequences in Table 5.4-1 considers both short- and long-term effects.

Table 5.4-1: Reserve Options Across the Effect Areas

EFFECT AREA: AIR QUALITY (POLLUTION)	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Overall air quality would improve compared to Status Quo, as habitat is protected and air pollution-causing development is restricted to previously developed areas. **RO-4** There would be a large increase in air pollution compared to Status Quo. Substantial amounts of replacement power would be required to compensate for the loss of the hydrosystem. This replacement power would likely come from increased use of natural gas and coal. In addition, increased truck and train traffic needed to compensate for the loss of barging would increase air emissions. Further, dam deconstruction and reservoir drawdown would result in high levels of dust and vehicle emissions, in the short term, although as deconstruction ended and the area naturally revegetated this source of pollution would be reduced. **RO-5** Overall air quality would improve compared to Status Quo, as industrial, residential, and commercial development is curtailed, and growth is restricted to previously developed areas. **Note:** If these Reserve Options are taken together, air quality in the Pacific Northwest could improve substantially. Habitat protection and restricted development would result in the need to import replacement power from other regions in order to compensate for the loss of hydro generation.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** There would be an increased potential for air pollution compared to Status Quo, as considerably less land is set aside for fish and wildlife. **RO-10** Fewer thermal resources would be constructed as existing hydro generation is optimized and new hydropower is developed to help meet demand. However, there may be some short term air impacts from dam construction. Increases in barging could also mean a reduction in air emissions from truck and rail traffic. These actions could result in improvements to air quality compared to Status Quo. **RO-11** There could be large increases in air pollution, compared to Status Quo, as the commercial uses of natural resources are maximized. Increased development and growth would further result in impaired air quality. The commercial use of natural resources could also result in a decrease in established carbon sinks, further limiting air quality.

EFFECT AREA: LAND HABITAT	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Substantially more land would be preserved, than compared to Status Quo, as more habitat including upland, riparian, and wetland areas, is protected. However, the quality of this habitat could vary radically. **RO-4** In the short term, riparian habitat would be eliminated as river boundaries

EFFECT AREA: LAND HABITAT	
	change due to breaching. New riparian habitat would gradually and naturally re-establish along new riverbanks and would fluctuate due to natural disturbances. There would also be more upland habitat, however, there would likely be a loss of permanent wetlands. Breaching the mainstem dams would result in substantially more land habitat compared to Status Quo. **RO-5** Restricting growth and development would result in much more available land habitat than Status Quo.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** There would be a dramatic decrease in available land habitat, compared to Status Quo, as less habitat is set aside. **RO-10** There would be substantially less land habitat, compared to Status Quo, as the commercial benefits o f the hydrosystem are maximized and new dams are constructed. The would be decreases in upland and riparian areas as new reservoirs inundate existing habitat, and ports, recreational and irrigation facilities are developed to meet commercial demand. Loss in riparian areas would likely result from increased fluctuation in reservoir levels as hydropower generation is optimized. However, there may be more adjacent wetland habitat as reservoirs are formed. **R-11** There would be large decrease in all types of land habitat, compared to Status Quo, as natural resources industries increase—forest products, mining, agriculture, and ranching. Further losses would also result from increased industrial, residential and commercial development.

EFFECT AREA: WATER HABITAT	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Overall water quality would improve compared to Status Quo as both land and water habitat are protected. This protection would likely result in decreases in non-thermal pollution, sedimentation, and temperature. Water quantity would also likely increase as protection minimizes consumptive uses of water. This would result in an overall increase in the amount of stream/river and reservoir habitat. **RO-4** In the short term, breaching the mainstem dams would result in increases in sedimentation and non-thermal pollution. In the long term, temperatures would fluctuate similarly to a natural river, which could result in periods of higher temperatures than Status Quo as controlled releases to lower temperatures are no longer possible. Nitrogen supersaturation would also be reduced to more natural river levels. Also, non-thermal pollution and sedimentation would improve. Water quantity and the amount of stream/river habitat would vary seasonally and annually, compared to Status Quo, as the ability to regulate the hydrologic regime of the river is lost. However, reservoir habitat would be eliminated as dams are breached. **RO-5** Overall water quality would improve compared to Status Quo, as sources of pollution (e.g. erosion from development activities, non-thermal pollution from agricultural runoff, and increased temperature from riparian development) are further restricted. Water quantity would also likely improve as water withdrawals are minimized, resulting in increased stream/river and reservoir habitat.

EFFECT AREA: WATER HABITAT	
RO-7 – RO-12 Extending Commerce Focus	**RO-1** Water quality would likely decrease, compared to Status Quo, as less habitat is set aside and more upland and riparian areas are developed causing increases in non-thermal pollution, sedimentation, and temperature. Water quantity, stream/river habitat, and reservoir habitat would also likely decrease as less protections could result in more water withdrawals. **RO-9** Maximizing artificial production of fish through private sector fish farms would likely result in decreases in water quality, compared to Status Quo. This decrease would likely be from increased non-thermal pollution and sedimentation from aquaculture discharges. Water quantity and stream/river habitat could be slightly reduced, locally, as water withdrawals increase. **RO-10** Maximizing the commercial benefits of the hydrosystem, including the construction of new dams, could result in decreased water quality. Increased hydropower generation would result in less spill—decreasing nitrogen supersaturation. However, nitrogen supersaturation levels could increase depending on the number of new dams constructed and the amount of spill. Temperatures would also likely increase as new reservoirs are created. Non-thermal pollution could increase as navigation increases. There may also be some short term increases in sedimentation from dam construction activities. Water quantity would be reduced as irrigation, municipal, and industrial withdrawals increase. The amount of stream/river habitat would decrease as dams are constructed resulting in increased reservoir habitat. **RO-11** Water quality would likely decrease, compared to Status Quo, as the commercial use of natural resources is maximized. There would be increases in non-thermal pollution, temperature, and sedimentation from activities such as increased logging, mining, and development. Water quantity would also likely decrease as more water is withdrawn for commercial use, this would result in a decrease in stream/river and reservoir habitat.

EFFECT AREA: FISH AND WILDLIFE: Native Anadromous Fish (Naturally-Spawning and Hatchery-Produced)	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** As all levels of habitat are protected, native anadromous fish would likely increase compared to Status Quo. Protections of both land and water habitat would result in improvements in water quality and quantity. **RO-2** The elimination of fish and wildlife harvest would result in increased native anadromous fish populations compared to Status Quo. However, as more prey species become available, predator numbers would increase. Anadromous fish populations would be limited by natural processes. **RO-3** The elimination of all hatchery-produced anadromous fish would likely result in increases in naturally-spawning anadromous fish in the long term. There may be some incidental mortality to naturally-spawning anadromous fish as hatchery-produced fish are actively removed. Overall, however, there would be much less anadromous fish in the river compared to Status Quo. **RO-**4 The removal of all mainstem dams would result in both short- and long-term effects on native anadromous fish. Short-terms adverse effects could include mortality due to elevated turbidity levels from increases in sedimentation, reduced rearing habitat, and reduced migratory habitat quality. However, there could also be reductions in predation on juveniles and increased

EFFECT AREA: FISH AND WILDLIFE: Native Anadromous Fish (Naturally-Spawning and Hatchery-Produced)	
	speed of migration times. The inability to store water for fish in dry years could result in increased fish mortality. Long-term effects could result in reduced passage mortality, improved overall water quality, decreased predation pressure, and increased available habitat. These improvements could result in substantially more anadromous fish compared to Status Quo. **RO-5** The restriction of growth and economic development would likely result in increases in native anadromous fish compared to Status Quo. As development decreases, pressure affecting the quality and quantity of their habitat would also decrease allowing for higher populations. **RO-6** The elimination of tribal fish and wildlife harvest would result in increased native anadromous fish populations compared to Status Quo. However, as more prey species become available, predator numbers would increase. Anadromous fish populations would be limited by natural processes.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less habitat is set aside, anadromous fish would likely decrease compared to Status Quo. Both the quality and amount of habitat would be reduced. **RO-8** Allowing unrestricted harvest of fish and wildlife would result in substantial decreases in native anadromous fish, potentially resulting in extinctions. There would also be a decrease in other fish species that are dependent on anadromous fish. Over-harvesting could result in a fundamental change in fish community structures. **RO-9** As artificial production of anadromous fish is maximized using fish farms, naturally-spawning anadromous fish would experience less pressure and competition from hatchery-produced anadromous and non-native resident fish species. This could result in an increase in naturally-spawning anadromous fish. Traditional hatchery-produced fish would likely be eliminated as private sector fish farming replaces subsidized hatchery production. There could be more pressure on naturally-spawning anadromous fish from the potential introductions of non-native species and disease. There would be a large increase in marketable farm reared anadromous fish. **RO-10** Maximizing the commercial benefits of the hydrosystem could result in decreases in native anadromous fish, as reservoirs would be operated for multiple uses such as flood control, irrigation, power production, and recreation. Building new dams could further reduce anadromous fish habitat, increase passage mortality and further delay migration time. Newly created reservoir habitat could also result in increased predator populations. There would likely be considerable reductions in native anadromous fish compared to Status Quo. **RO-11** Maximizing the commercial use of natural resources would likely reduce native anadromous fish compared to Status Quo. Impacts from resource use, extraction, and development would result in a decrease in the amount and quality of habitat and could create increased restrictions to passage. **RO-12** Allowing unrestricted tribal harvest of fish and wildlife would result in substantial decreases in native anadromous fish, potentially resulting in extinctions. There would also be a decrease in other fish species that are dependent on anadromous fish. Over-harvesting could result in a fundamental change in fish community structures.

EFFECT AREA: FISH AND WILDLIFE: Native Resident Fish	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** As all levels of habitat are protected, resident fish would likely increase compared to Status Quo. Protections would result in improvements in water quality and quantity. **RO-2** The elimination of fish and wildlife harvest would result in increased native resident fish populations compared to Status Quo. As more prey species become available, predator numbers would increase. Resident fish populations would be limited by natural processes. **RO-3** The elimination of all hatchery-produced fish would likely result in increases in native resident fish. The reduction in competition with hatchery-produced anadromous fish and hatchery-produced non-native fish would allow for native resident fish expansions. **RO-4** The breaching of all the mainstem dams could result in short term decreases in native resident fish as habitat and sources of food are reduced. In the long term native resident fish would likely increase in number and expand in range as blockages are removed. **RO-5** The restriction of growth and economic development would likely result in increases in native resident fish compared to Status Quo. As development decreases, the quality and quantity of their habitat would increase allowing for higher populations. **RO-6** The elimination of tribal fish and wildlife harvest would result in increased native resident fish populations compared to Status Quo. As more prey species become available, predator numbers would increase. Resident fish populations would be limited by natural processes.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less habitat is set aside, resident fish would likely decrease compared to Status Quo from reductions in quality and amount of habitat. **RO-8** Allowing unrestricted harvest of fish and wildlife would result in substantial decreases in targeted native resident fish, potentially resulting in extinctions. There would also be a decrease in other resident fish species that are dependent on targeted ones. Over-harvesting could result in a fundamental change in fish community structures. **RO-9** As artificial production of fish is maximized using fish farms there would be less pressure on native resident fish from hatchery-produced anadromous and non-native species. This could result in an increase in native resident fish. However, resident fish may still be limited by previously established non-native species. **RO-10** Maximizing the commercial benefits of the hydrosystem could result in decreases in native resident fish, as reservoirs would be operated for multiple uses such as flood control, irrigation, power production, and recreation. Building new dams could create more habitat for native resident fish, however, they would still be limited by competition with non-native fish. **RO-11** Maximizing the commercial use of natural resources would likely reduce native resident fish compared to Status Quo. Impacts from resource use, extraction, and development would result in a decrease in the amount and quality of habitat. **RO-12** Allowing unrestricted tribal harvest of fish and wildlife would result in substantial decreases in targeted native resident fish, potentially resulting in extinctions. There would also be a decrease in other resident fish species that

EFFECT AREA: FISH AND WILDLIFE: Native Resident Fish	
	are dependent on targeted ones. Over-harvesting could result in a fundamental change in fish community structures.

EFFECT AREA: FISH AND WILDLIFE: Native Wildlife	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** As all levels of habitat are protected wildlife would increase compared to Status Quo. Areas that would otherwise have been developed would now provide habitat and wildlife would be limited only by carrying capacity. Species diversity could decrease as climax ecosystems are approached, however, natural disturbance may counteract this effect. **RO-2** The elimination of fish and wildlife harvest would result in increased wildlife populations compared to Status Quo. As more prey species become available, predator numbers would increase. Wildlife populations would be controlled through natural processes. **RO-3** Eliminating all hatchery-produced fish would result in decreases in wildlife populations that depend on them. This decrease could reverse as naturally-spawning fish return or other prey species are substituted. **RO-4** The breaching of all mainstem dams would result in species-specific effects. Some wildlife species dependant on reservoir habitat would decrease in number, while other species needing more natural river conditions would increase. Specifically, some species (e.g. birds) that prey migrating salmon would be reduced as fishladders and juvenile bypass systems are eliminated. Some wildlife populations may also be decreased as land is developed for new generation resources or improved rail and road infrastructure. **RO-5** As growth and economic developed is restricted, there would be less pressure on wildlife and more available habitat. This would result in increases in wildlife populations compared to Status Quo. **RO-6** The elimination of tribal fish and wildlife harvest would result in increased wildlife populations compared to Status Quo. As more prey species become available, predator numbers would increase. Wildlife populations would be controlled through natural processes.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less habitat is set aside, wildlife populations that require more undisturbed areas would be reduced. However, those species that have adapted well to human development would likely increase. Predator species that rely on prey affected by habitat loss would also decrease. **RO-8** Allowing unrestricted harvest of fish and wildlife would result in substantial decreases in targeted wildlife species, potentially resulting in extinctions. There would also be a decrease in other wildlife species that are dependent on targeted ones. **RO-9** Maximizing fish production through fish farming would result in the decrease in wildlife dependant on fish. Nuisance wildlife attracted to fish farms would likely be killed, and the decrease in in-river hatchery-produced fish would result in further wildlife decreases. **RO-10** As the commercial benefits of the hydrosystem are maximized wildlife populations would likely be impacted. The creation of more dams would decrease populations requiring river conditions while increasing those species dependant on reservoir habitat. Increased development and recreation of the

EFFECT AREA: FISH AND WILDLIFE: Native Wildlife	
	hydrosystem would further limit wildlife populations. **RO-11** As the commercial use of natural resources are maximized, wildlife species that depend on those resources would decrease substantially. **RO-12** Allowing unrestricted tribal harvest of fish and wildlife would result in substantial decreases in targeted wildlife species, potentially resulting in extinctions. There would also be a decrease in other wildlife species that are dependent on targeted ones.

EFFECT AREA: FISH AND WILDLIFE: Non-Native Species	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** As all levels of habitat are protected non-native species would increase compared to Status Quo, mainly in areas where they are already established. As areas that would otherwise have been developed are now protected the spread of non-native species may slow and some species may be reduced. **RO-2** As harvest of fish and wildlife is eliminated those non-native species that are more adapted and can out-compete native species will increase. However, if harvest was the factor suppressing native species then there expected increase in number could allow them to out-compete non-native species. There also may be an increase in non-native species if they were the target of tribal harvest. **RO-3** The elimination of all hatchery-produced fish would likely reduce some non-native species, as non-native species hatchery production would be discontinued. Non-native species that prey on hatchery produced fish would also be reduced. **RO-4** The removal of all mainstem dams would likely result in the decrease in non-native species that have adapted to the warm water reservoir environment. The removal of non-native colonization habitat (e.g. intake pipes, screens) would also reduce non-native species. Some opportunistic species may be able to expand their range as blockages are removed. Other opportunities for introductions could occur as land is developed for new generation resources or improved rail and road infrastructure. **RO-5** As growth and economic development are curtailed more habitat would become available for non-native species. However, some non-natives dependant on developed landscapes would be reduced. **RO-6** As harvest of tribal fish and wildlife is eliminated those non-native species that are more adapted and can out-compete native species will increase. However, if harvest was the factor suppressing native species then there expected increase in number could allow them to out-compete non-native species. There also may be an increase in non-native species if they were the target of tribal harvest.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less habitat is set aside, non-native species that have adapted well to human development would likely increase compared to Status Quo. **RO-8** Allowing unrestricted harvest of fish and wildlife would result in substantial decreases in targeted non-native species, potentially resulting in extirpations. There would also be a decrease in other non-native species that are dependent on native fish and wildlife that are harvested. However, there could also be some increases as niches become available as a result of harvested native

EFFECT AREA: FISH AND WILDLIFE: Non-Native Species	
	species. **RO-9** Maximizing artificial production through fish farming that target production of non-native species could result in a large increases. Other non-native species may also increase as control programs targeted to benefit native species are discontinued. **RO-10** Maximizing navigation and recreation could result in substantial increases in non-native species. Also the creation of more dams could result in more habitat for non-native species colonization. **RO-11** The spread of non-native species may increase, compared to Status Quo, as introductions result from increased development. **RO-12** Allowing unrestricted tribal harvest of fish and wildlife would result in substantial decreases in targeted non-native species, potentially resulting in extirpations. There would also be a decrease in other non-native species that are dependent on native fish and wildlife that are harvested. However, there could also be some increases as niches become available as a result of harvested native species.

EFFECT AREA: COMMERCIAL INTERESTS	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** As all levels of habitat are protected, commercial interests would likely be substantially affected compared to Status Quo. More restrictions would be placed on industries in order to preserve protected areas. Expansions of existing industries would also be limited by available space for development. There may be some benefits as existing developed areas and industries are modernized to become more efficient. Natural resource-based industries would be the most affected as areas would be closed off from exploration, extraction, and logging. **RO-2** The elimination of all fish harvest would substantially affect commercial fishing compared to Status Quo. The commercial fishing industry would be eliminated and many local communities dependant on commercial fishing and associated industries would be economically crippled. Transportation would also be affected as it pertained to transporting fish products. **RO-3** The elimination of all hatchery-produced fish would seriously affect the commercial fishing industry. In-river commercial fishing would be virtually eliminated, as the available amount of harvestable fish is dramatically decreased. Ocean-based commercial fishing could also decline as numbers of fish decrease. The effect might not be as harsh as experienced by in-river commercial fishing since the ocean fishery could target other stocks/species more easily. Many local communities dependant on the fishing industry would also be adversely affected. Transportation would also be affected as it pertained to transporting fish products. **RO-4** Breaching all mainstem dams would have far-reaching, substantial effects on commercial interests compared to Status Quo. The ability to generate power from the river would be eliminated, and other sources of generation would be required. The existing transmission system would be largely ineffective as it is largely based on delivering hydro-generated power, and new transmission would be needed to connect new sources of power. Navigation, at least upriver of Portland, would be completely eliminated as the lock system is

EFFECT AREA: COMMERCIAL INTERESTS	
	removed and passage is blocked from newly exposed rocks and falls. Train- and truck-based transportation would expand to meet demand, requiring significant investments in infrastructure development. Irrigated agriculture and ranching would be seriously impacted as reservoirs are lost and the amount of available water is reduced. Large investments would be required to reconfigure irrigation systems, and many farms and ranches would have to shift to dry land farming/ranching or be forced out of business. Agriculture and forest products would be further impacted by the loss of navigation and increased cost of transporting goods to market. The impacts to commercial fishing would vary in degree depending on its location, however, all commercial fishing would experience a decrease in the available fish for harvest, at least in the short-term. The treaty Indian gillnet fishery that extends from Bonneville Dam to McNary Dam would be the most impacted a the river returns to more natural conditions. The non-Indian gillnet fishery, operating below Bonneville Dam, would be also be impacted as dams are removed and fish numbers decrease. Of the three the commercial ocean fishery would likely be least affected. Many local communities dependant on the fishing industry would also be adversely affected. Transportation would also be affected as it pertained to transporting fish products. Other industries would also be severely affected by the loss of all mainstem dams. Many of these industries rely on the inexpensive power generated by the hydrosystem and on water withdrawals. The loss of power would result in increased operating costs, which could lead to closings. As navigation is lost, the cost to transport their goods increases as well. **RO-5** The restriction of growth and economic development would likely benefit existing commercial interests, though they would be limited by the inability to expand. Reduced competition would result in benefits to all areas of commerce. The hydropower and transmission system would likely be able to supply the majority of needed power and the navigation system would continue to provide for the inexpensive transportation of goods. **RO-6** The elimination of tribal harvest would likely have beneficial effects on commercial fishing as more fish would become available for harvest. This could result in increases in commercial fishing-based industries and transportation.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less land is set aside many commercial interests will benefit, compared to Status Quo. Increased commercial development would result in the need for increased power, transmission, and transportation. Opportunities would exist for the expansion of agricultural, ranching, forest products, and other industries. These commercial interest would be less affected by costs associated with environmental and land use regulations and limited only by market forces. Commercial fishing could be adversely affected if increased non-fishing commercial activity resulted in decreased water quality and reduced numbers of fish. **RO-8** Allowing unrestricted harvest would substantially benefit the commercial fishing industry. It would no longer be limited by ESA restrictions on harvest. In turn, communities dependant on commercial fishing would likely flourish and fish product transportation could increase. However, these are only short-term effects. In the long term, unrestricted harvest could result in the collapse of the commercial fishing industry. **RO-9** Maximizing artificial production through fish farming would likely affect the commercial fishing and transportation industries. Traditional commercial fishing would be adversely affected as private sector fish farming expands and

EFFECT AREA: COMMERCIAL INTERESTS	
	the amount of hatchery production decreases. However, the fish processing industries and fish product transportation would benefit as more fish are being produced for market. **RO-10** Maximizing the commercial benefits of the hydrosystem, including the construction of additional dams, would likely result in benefits to most commercial interests compared to Status Quo. The ability to generate inexpensive power would increase, although additional transmission would be required. Existing dams would be operated for power production, navigation, flood control, and irrigation. These would provide benefits to navigation, and the industries that use it; agriculture, ranching, and forest products; and many other industries. **RO-11** Maximizing the commercial use of natural resources would benefit most sectors of commercial interests. Agriculture, ranching, forest products, and mining would increase as restrictions are lifted and more use and production is allowed. With the increase in raw material supply, other industries would also increase production, limited by demand. There would also be increases in transportation as more materials are being transported. The increased production of goods would result in the need for more power production, which would require transmission expansions. Commercial fish harvest may be somewhat adversely affected as water quality and quantity are reduced—further decreasing naturally-spawning fish. **RO-12** The elimination of tribal harvest would result in some benefits to commercial fishing as more fish would be available for harvest.

EFFECT AREA: RECREATION	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Protecting all levels of habitat would benefit recreation more than Status Quo. Newly protected areas could result in higher natural fish and wildlife production, potentially benefiting sport fishing and hunting. Other natural resource-based recreation would also increase as more areas become available for use. Developed recreation would likely decrease as development restrictions in protected areas would limit growth. Recreation could be limited if overuse resulted in habitat degradation. **RO-2** The elimination of all fish and wildlife harvest would impact sport fishing and hunting more than Status Quo, however, increased wildlife viewing opportunities could result in beneficial effects on other recreation. **RO-3** The elimination of all hatchery-produced fish would have substantial effects on sport fishing, though hunting and other types of recreation would be unaffected. Since a substantial amount of recreational freshwater fishing is dependant on hatchery-produced fish, the elimination of these fish would severely restrict sport fishing opportunities. **RO-4** Breaching all mainstem dams would have major impacts on all types of land- and water-based recreation that have developed around the Federal hydrosystem. All reservoir sport fishing would be eliminated, as well as other types of flatwater recreation. The loss of navigation would eliminate the use of the river for large recreational boats. There may also be some reductions in hunting opportunities, especially for waterfowl. Some recreation, such as

EFFECT AREA: RECREATION	
	kayaking and rafting, might increase. **RO-5** Restricting growth and economic development would likely result in increased recreational opportunities, however, developed recreation would likely decrease. There may also be a decrease in recreation support services as economic development is limited. Sport fishing and hunting opportunities would likely increase in response to growing populations of fish and wildlife. **RO-6** The elimination of tribal fish and wildlife harvest would likely result in increased opportunities for sport fishing and hunting as competition with tribal fishermen and hunters is reduced, and more fish and wildlife become available. Other types of recreation would unlikely be affected.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less land is set aside, sport fish and hunting and other types of recreation would likely be impacted more than under Status Quo. As the amount of area available for recreation is reduced, crowding would increase and recreational enjoyment would be reduced. Some recreation could increase, especially developed recreation, if the commercial value of an area for a particular type of recreation is higher than setting it aside. There may also be some increases in recreational support services catering to tourism. **RO-8** Allowing unrestricted harvest would result in many more opportunities for sport fishing and hunting compared to Status Quo. However, other types of recreation could be impacted as species, especially wildlife, become scarce. **RO-9** Maximizing artificial production of fish through fish farming could impact recreational interests. Sport fishing would be worse since the amount of harvestable fish in the rivers would be dramatically less, as production shifts from hatcheries to fish farms. However, fishing opportunities for other fish species would still be available. Hunting and other types of recreational activities would be largely unaffected. **RO-10** Maximizing the commercial benefits of the hydrosystem could result in substantial impacts to recreation. As new dams are built, river-based recreation would likely be reduced. However, recreation based around reservoirs would increase. There would be a decrease in sport fishing for those who enjoy fishing in a river environment; however, there would be increases in reservoir fishing opportunities. Reservoirs would be managed, in part, for recreational purposes, allowing expanded uses for camping, swimming, and fishing. There would likely be some lost hunting opportunities as areas are inundated for reservoirs; however, the creation of wetland and reservoir habitat would allow expanded waterfowl hunting. **RO-11** Maximizing the commercial use of natural resources would likely reduce recreational opportunities more than Status Quo. As areas used for land-based recreation (including hunting) are cleared, recreational opportunities would decrease. Water-based recreation (including fishing) would be impacted by changes to hydrology, water quality, and reduced populations of fish. **RO-12** Allowing unrestricted tribal harvest could result in decreases in sport fishing and hunting. As tribal harvest increases, there would likely be less fish and wildlife available for harvest and more competition for the resource. Other types of recreation would probably not be affected.

EFFECT AREA: ECONOMIC DEVELOPMENT	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** The protection of all levels of habitat would result in decreases to economic development compared to Status Quo. Industrial, residential, and commercial development would be restricted as areas that could be developed are protected. This restriction could also have effects on employment as the expansion of commercial interests is restricted and new employment opportunities are lost. **RO-2** The elimination of all harvest would result in economic development conditions that are worse, compared to Status Quo. As the regional commercial fishing industry collapses, unemployment in the fishing industry would increase. This would have serious effects on entire communities dependant on the commercial fishing industry. Besides high unemployment, there be would effects to industrial, residential, and commercial development in these coastal and fish-dependant communities. Some economic development may occur as the local economies shift to another revenue source. However, it would not compensate for the loss of commercial fishing. **RO-3** The elimination of all hatcheries and hatchery-produced fish would have substantial effects on economic development. The loss of hatchery-produced fish would have serious consequences to the commercial and recreational fishing industries. This reduction in harvestable fish would result in higher unemployment from hatchery closures and loss of fishing opportunities. Many local communities dependant on the fishing industry would also be adversely affected. This would in turn curtail industrial, residential, and commercial development. **RO-4** Breaching all mainstem dams would have substantial effects on economic development compared to Status Quo. Unemployment rates would rise quickly as industries dependant on inexpensive power, irrigation, reservoir recreation, and navigation would experience huge cost increases or complete loss. There may be some increases in other recreation, however, it would not offset the effects of breaching. High unemployment and operation costs would further restrict industrial, residential, and commercial growth. **RO-5** Restricting growth and curtailing economic development would have substantial effects on regional economic development compared to Status Quo. Restricting growth would result in higher unemployment in the Region and depressed industrial, residential, and commercial development. This would likely result in a higher poverty and increases in accompanying social problems.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less habitat is set aside, economic development would likely do much better compared to Status Quo. With more available land, industrial, residential, and commercial development would increase. Along with increases in other commercial sectors, this increase in development would further increase the number of new jobs available, reducing unemployment. **RO-8** Allowing unrestricted harvest would likely lead to increased economic development. As harvest limitations are removed, there would be more employment opportunities in the commercial fishing industry. The increase in revenue created by increased harvest would result in more industrial, residential, and commercial development as money gets reinvested in the local economies. This would further increase employment opportunities. However, these are only short-term effects. In the long term, unrestricted harvest could result in the collapse of the commercial fishing industry.

EFFECT AREA: ECONOMIC DEVELOPMENT	
	RO-9 Maximizing artificial production of fish through private sector fish farming would likely have positive effects on economic development compared to Status Quo. There would likely be some trade-offs as the commercial fishing industry is impacted, but those impacts would be limited to particular sectors of the commercial fishing industry. Employment could increase as production increases. As more revenue is created, more development could occur. **RO-10** Maximizing the commercial benefits of the hydrosystem, including constructing new dams, would have substantial benefits to economic development compared to Status Quo. Most economic sectors would experience increases in employment and industrial, residential, and commercial development. Increased revenue as a result of inexpensive power and reduced operation costs would result in increased regional economic growth. There may be some losses associated with the commercial fishing and recreation industries; however, increases in other commercial sectors will offset them. **RO-11** Maximizing the commercial use of natural resources would result in substantial increases to regional economic development compared to Status Quo. As more raw materials are produced (e.g. timber, sand and gravel, crops) other commercial sectors would increase. There would be substantial increases in employment as all sectors involved in natural resource production, processing, and manufacturing would increase. However, these are only short-term effects. In the long term, unrestricted development could result in the serious depletion of natural resources resulting in economic decline.

EFFECT AREA: FUNDING COSTS	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** As all levels of habitat are protected funding costs would increase compared to Status Quo. Ratepayer funding of habitat protection would be limited by MSR and limited to the obligations to mitigate or aid in endangered species recovery. Other sources, such as Federal and state government agencies, would also be required to meet their obligations and would be expected to provide additional funding if more habitat is protected. **RO-2** The elimination of fish and wildlife harvest would have some effects on funding costs compared to Status Quo. Responsibilities to compensate for declining fish stocks would be shorter lived as the elimination of fish harvest would likely result in increased natural production. Other funding sources would likely be negatively impacted from the elimination of harvest. For example, some sources obtain their revenue and funding through the sale of fish and wildlife hunting licenses and fees. This lack of revenue may make it more difficult for other sources to fund fish and wildlife costs. **RO-3** The elimination of all hatcheries and hatchery-produced fish would likely result in a decrease in the ability to fund fish and wildlife costs. Other funding sources would also be limited in their funding as reductions in hatchery-produced fish may result in decreased revenues from fishing licenses. Ratepayer funding would be limited to MSR and any increased costs would likely be transferred to other funding sources. **RO-4** Breaching all mainstem dams would have substantial effects on funding costs. Ratepayers would no longer be responsible for mitigation or recovery costs associated with the dams. However, ratepayers may still be required to

EFFECT AREA: FUNDING COSTS	
	pay for some transmission-related mitigation. Other funding sources would be required to fund any continuing recovery or mitigation efforts. If species continue to decline, other funding sources may not be able to meet their costs. **RO-5** Restricted growth and economic development would likely result in more difficulty in covering funding costs compared to Status Quo. Reduced demand for power from a decrease in economic development would result in less revenue and therefore less ability to fund fish and wildlife costs. Other funding sources would be affected similarly as reduced employment and economic growth results in less tax revenue and fishing and hunting licenses sold. **RO-6** The elimination of tribal harvest would have some effects on funding costs. This would be a change in current Federal policy and, depending upon the circumstances, could be a taking of treaty rights requiring compensation from Federal appropriations.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** As less habitat is set aside, ratepayers would likely be able to maintain their ability to fund fish and wildlife costs, although funding priorities may shift. Ratepayer funding would be limited to MSR and any increased costs would likely be transferred to other funding sources. Other Federal funding sources could benefit, as there would a decrease in habitat mitigation efforts. However, state funding may be limited because of reductions in revenues from hunting and fishing licenses. **RO-8** Allowing unrestricted harvest would likely have no effect on ratepayer funding costs. However, other sources may be required to increase artificial production efforts or other measures to sustain the harvest. This could result in substantial funding costs for other sources. In order to meet funding requirements, many of the costs associated with maintaining unrestricted harvest may be passed on to the industry. **RO-9** Maximizing artificial production through fish farming would likely reduce the amount of funding costs for ratepayers and other sources. Private sector aquaculture would reduce the need for mitigation/supplementation hatchery production. There would still be funding costs associated with fish and wildlife mitigation and recovery activities, though they may be reduced. **RO-10** Maximizing the commercial benefits of the hydrosystem, including constructing new Federal dams, would have substantial effects on funding costs. Some of the revenue generated by increased power production would likely be used to meet new fish and wildlife mitigation and recovery activities as more land is inundated and more blockages to anadromous fish migrations are constructed. Ratepayer funding costs would likely increase dramatically, however, there would likely be matched with increased revenues. Other funding sources could have more difficulty in meeting their funding costs. Although there would be more tax revenue from commercial development, there would be a decrease in revenue associated with the anadromous fish harvest. **RO-11** Maximizing the commercial use of natural resources would likely have some effects on funding costs. There would unlikely be any additional costs to ratepayers. However, other funding sources would likely experience increased funding costs required to mitigate for increased resource development. Some of the revenues generated from this increased development would be used to meet fish and wildlife costs. Therefore, other funding sources would likely be able meet their funding costs. **RO-12** Allowing unrestricted tribal harvest would have little effect on ratepayer funding costs, compared to Status Quo. However, other funding sources may

EFFECT AREA: FUNDING COSTS	
	experience increased funding costs as monies are spent to increase fish production. This increase in production would be needed to compensate non-tribal harvest.

EFFECT AREA: TRIBAL INTERESTS	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Protecting all levels of habitat would benefit tribal interests more than Status Quo. Newly protected areas could result in higher natural fish production, potentially benefiting tribal fish harvest. Other areas where important wildlife and plants are found would also be protected. This protection would allow for increased tribal tradition and health, as well as spirituality as areas return to a more natural appearance. **RO-2** The elimination of all non-tribal fish and wildlife harvest would likely result in increase tribal hunting and fishing opportunities, as competition with non-tribal fishermen and hunters is reduced, and more fish and wildlife become available. Increased harvest opportunities would result in increased tribal health, tradition, and spirituality. **RO-3** The elimination of all hatchery-produced fish would likely impact tribal harvest, health, and tradition more than Status Quo, as reduced fish numbers would result. Spirituality could benefit from the knowledge that the rivers are only full of naturally-spawning fish, however it may also be adversely affected as the availability of salmon for ceremonial use would decrease. **RO-4** Removing all mainstem dams would likely result in short-term decreases in tribal fish harvest, until populations recover. This reduction in harvest could impact tribal health, spirituality and tradition. Further health problems could arise from increases in heavy metal bioaccumulation in fish. However, spirituality may be improved as a more natural river develops. **RO-5** Restricted growth and economic development would likely impact tribal health as unemployment rates increase. Spirituality and tradition could also decline as poverty and accompanying social problems increase. **RO-6** Since fish and wildlife are such an important component of native American Indian diet and culture, the elimination of tribal fish and wildlife harvest would substantially impact tribal fish harvest, health, spirituality, and tradition compared to Status Quo.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** The reduction in the amount of habitat set aside would result in substantial impacts to tribal interests compared to Status Quo. There would be fewer opportunities to harvest fish, wildlife, and plants, as well as experience the spiritual values of undeveloped lands important to the particular tribe. **RO-8** Allowing unrestricted harvest could have two different effects on tribal interests. Increased commercial and recreational harvest could result in increased competition to tribal subsistence and ceremonial harvest affecting tribal harvest, health, spirituality, and tradition. However, increased harvest for commercial tribal harvest would likely result in increased tribal health, as employment increases. **RO-9** Maximizing artificial production of fish through fish farming could impact tribal interests compared to Status Quo. Tribal fish harvest for subsistence and ceremonial purposes would be worse since the amount of

EFFECT AREA: TRIBAL INTERESTS	
	harvestable fish in the rivers would be dramatically less. However, salmon would be readily available thereby allowing tradition to continue, though somewhat more limited. Since salmon are important for health, increased salmon production would allow for increased tribal health. Spirituality could be impacted based on the decreased number of fish in the rivers. **RO-10** Maximizing the commercial benefits of the hydrosystem could result in substantial impacts to tribal fish harvest, health, spirituality, and tradition. As new dams are built, lands used for traditional and spiritual uses would be lost. Fish harvest will be severely impacted by changes in hydro operations for irrigation, transportation, and power generation. There may still be some harvest opportunities as reservoirs are managed for recreational purposes. **RO-11** As commercial uses of natural resources increase, tribal harvest, health, tradition, and spirituality would be adversely affected. The loss of habitat through resource use, extraction and development could affect fish and wildlife habitat, destroy important plants, and destroy places of spiritual value. **RO-12** Allowing unrestricted tribal harvest of fish and wildlife would result in beneficial effects on tribal harvest, health, tradition, and spirituality. As more ceremonial and subsistence harvest is allowed, health, tradition, and spirituality increases.

EFFECT AREA: CULTURAL AND HISTORIC RESOURCES	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Protecting all levels of habitat would reduce the effects on cultural and historic resources, compared to Status Quo, as resources are less likely to be disturbed. **RO-4** Breaching the mainstem dams would result in the exposure of many cultural and historic sites. These sites could be impacted by exposure to the elements, vandalism, and theft. Construction of new power resources and transmission facilities could further impact cultural and historic sites. **RO-5** Further restricting growth and curtailing economic development would likely result in decreased effects on cultural and historic resources compared to Status Quo. The decrease in ground disturbance and land clearing for development purposes would reduce exposure and destruction of these sites.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** Compared to Status Quo, there would likely be more impacts to cultural and historic resources, as less land is set aside and more development occurs. **RO-10** Operation of the hydrosystem to maximize commercial benefits would result in less fluctuation of river and reservoir levels, thereby resulting in less exposure and damage to cultural and historic resources. Further construction of dams would result in the inundation of more land, limiting the accessibility of these sites. **RO-11** The maximized commercial use of natural resources would result in more impacts to cultural and historic resources as these activities would disturb more ground and result in more land clearing.

EFFECT AREA: AESTHETICS	
Reserve Options	**Effect in Comparison to the Status Quo Condition:**
RO 1 – RO-6 Extending Natural Focus	**RO-1** Protecting all levels of habitat would likely increase the aesthetics compared to Status Quo. By protecting a variety of habitat types, more aesthetic value could be extended to more people. **RO-4** In the short term, breaching the mainstem dams would result in exposed mud flats that could be offensive to the olfactory and visual senses. However, in the long term, aesthetics would be increased as a free-flowing river is established. Aesthetic value could be diminished for those who prefer developed landscapes. **RO-5** Aesthetics for those who enjoy natural landscapes could increase as growth and economic development is curtailed. However, aesthetics for those who appreciated developed landscapes could be reduced.
RO-7 – RO-12 Extending Commerce Focus	**RO-7** Aesthetics for those who enjoy natural landscapes could decrease as less habitat is set aside, however, aesthetics for those who appreciated developed landscapes would increase. **RO-10** Aesthetics for those who enjoy natural landscapes could decrease, compared to Status Quo, as the hydrosystem is further developed. However, aesthetics would increase for those who appreciate the commercial values of the river and prefer developed landscapes. **RO-11** Maximizing the use of natural resources would likely result in decreased aesthetics, compared to Status Quo. Increased urbanization and industrialization typically would result in negative visual effects. Some industrial development could result in increased odors or sounds, further limiting an areas aesthetic appeal. However, aesthetics would increase for those who prefer developed landscapes.

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